Dr. Johann Friederich Eschscholtz

Portrait furnished through the kindness of Dr. Nicolas N. Maximow, Professor of Plant Physiology in the Institute of Applied Botany, Leningrad, Union of Socialized Soviet Republics, and Dr. Tatiana A. Maximow, Professor of Botany, Institute of Applied Botany, Leningrad. See p. 253 for a note on the visit of Eschscholtz to California.

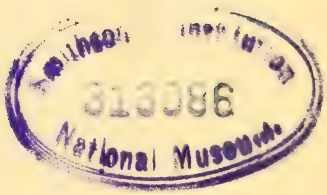
Frontispiece to Vol. 1, Madroño.

MADROÑO

JOURNAL OF THE CALIFORNIA BOTANICAL SOCIETY

VOL. I
1916 - - 1929

EDITED FOR THE SOCIETY
BY
WILLIS LINN JEPSON



BERKELEY, CALIFORNIA
1929

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VOLUME I NUMBER 1

MADROÑO

Journal of

THE
CALIFORNIA BOTANICAL
SOCIETY

Contents

[*Issued May 20, 1916*]

JOURNAL OF
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An Illustrated Magazine of the Natural History of the native and exotic plants of California

Issued at irregular intervals

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California Botanical Society

The purpose of the Society is to promote investigation of the life history, habits, classification and floristic distribution of Californian and other plants.

It plans to diffuse knowledge concerning them in a way calculated to develop and strengthen interest in botanical science in California. The Society holds meetings for lectures and discussions, arranges field meetings and indoor demonstrations, makes collections and publishes a journal. It takes an active interest in the conservation of the native life of California and coöperates with other organizations in preventing threatened destruction of remarkable individual plants or plant societies in California.

FOUNDING OF THE SOCIETY.

THE first meeting was held at the Oakland Public Museum on April 12, 1913, at 4 o'clock, to consider the advisability and possibility of forming a Botanical Society for California.

Dr. W. F. Badè was chosen as temporary chairman and Mrs. D. W. de Veer as temporary secretary. The meeting having been called at the instance of Dr. W. L. Jepson, he was asked by the chair to state his views.

A botanical society, said Dr. Jepson, ought to have two aims—the promotion of botanical research, and the diffusion of accurate botanical knowledge, in an accessible form, amongst the people. Botany should not be the property of a small cult or a select few, but it should be a science with a broad outlook in its relation to other sciences and to the humanities. It should play its due part in the progress of civilization in California.

With any such end in view, botanical science, for its proper development, must have the support of the people of California, and with such support accorded, the people of California are entitled to have at their command the best results of recent botany in a form suited to their needs.

The speaker felt that a society composed of both professional and amateur botanists would best serve the interests of the State. The interchange of ideas in such a society by people of diverse interests would be valuable. Our station on the most traveled, round-the-world route, would enable us to entertain many traveling botanists and secure the benefit of their experience.

Dr. Badè expressed the belief that inasmuch as the field for botanical research in California is unique and quite wonderful, there should be a large organization, and that from the nature of the field, it would be found advisable to have various sections to investigate various places of the plant life of the State.

A temporary organization was thereupon effected. The following provisional officers were elected: President, Dr. W. L. Jepson; First Vice-President, Guy Smith; Second Vice-President, Dr. W. F. Badè; Secretary-Treasurer, Mrs. D. W. de Veer; Corresponding Secretary, Miss Mary W. Tyrrell, and a meeting called for April 26th, in order that a larger number of persons might participate in the organization.

The following persons were present at the first meeting: Dr. W. L. Jepson, Dr. W. F. Badè, Mr. Charles S. Greene, Mr. C. P. Wilcomb, Miss Mary W. Tyrrell, Miss A. Gertrude Anthony, Miss Henrietta Burroughs, Miss Ethel C. Ayer, Miss Mary A. Darby, Miss Rowena Beans, Mrs. Calvert Meade, Mrs. Edward A. Kluegel, Mrs. D. W. de Veer, Mr. V. L. Minehart, Mr. Guy Smith, Miss Inez Deming, Mrs. J. G. Lemmon.

REGENERATION IN MANZANITA.

Willis L. Jepson.

In the Oakland Hills there may be found two manzanitas that are species of *Arctostaphylos* growing in localized areas. *Arctostaphylos andersonii* Gray grows on the main ridge a mile south of the summit of the Snake Road which leads into the headwater basin of San Leandro Creek. *Arctostaphylos glandulosa* Eastw. grows on the same ridge on yellow shale, and also abundantly on Moraga Ridge on the same formation. A number of years ago while making field studies of these shrubs, my attention was directed to the rather striking fact that individuals of *Arctostaphylos andersonii* had been killed outright by fire, and that *Arctostaphylos glandulosa* was stump-sprouting abundantly from heavy root-crowns. No root-crown or tabular development at base of the stem could be found in the former species, nor even any attempts at root sprouting at all, while in the case of the latter species the root-crowns became very heavy, globose, or turnip-shaped, or even eventually forming broad tabular areas of irregular shape at the surface of the ground. Since then many further observations have been made upon the species of this genus in various parts of the state to determine if reaction to fire ran parallel with the specific limitations.

Arctostaphylos andersonii is a larger shrub, eight to twelve feet high. One individual within a few feet of the bridle-path along the eastern brow of the Oakland Hills, and about half-mile south of Snake Road summit, is sixteen feet high, with a trunk circumference of three feet nine inches, at six inches above the ground. As said above, this species is killed by fire. Trunks decapitated four feet high failed to regenerate. This species may be recognized by its densely set leaves, which are heart-shaped at base, and by its very close flower-clusters. (Pl. I.)

Arctostaphylos glandulosa. This is a rather low-growing species of the immediate coast region, occurring in formations of considerable extent on slopes of yellow shale. It is perhaps the most remarkable species in California in the matter of its behavior under repeated fire devastation. After the stems are fire-killed, young plants begin to form a root-crown which becomes turnip-shaped or globose (Fig. 1) and lies immediately at or below the surface of the ground. As the plants increase in age and fires continue to run, as characteristically in chaparral, the root-crowns increase in size (Pl. II, A) and give rise to many stems. While at first small, root-crowns often become two to five, or indeed ten to thirteen, feet broad.

The very large ones form irregular circles or crescent-shaped areas, and are truly remarkable structures. (Fig. 2) Such crowns can be studied to advantage upon the southeastern slopes of Mt. Tamalpais or in the Oakland Hills just south of the low wagon pass

Arctostaphylos andersonii

at the headwaters of Kohler Creek, and along the summit of Moraga Ridge, where the species is associated with Knob-cone pine in a characteristic habitat. The vitality of the species must be normally very great. After the Mt. Tamalpais chaparral fire of early July, 1913, sprouts began to appear within four weeks, and in two months made an abundant showing. Two of my students, Wieslander and Herbert, counted forty-eight sprouts in a square inch from the crown of an individual of this species occurring on Mt. Tamalpais in the area subject to the fires just mentioned.

FIG. 1.

Arctostaphylos vestita. This species occurs on the Monterey Peninsula in company with the Monterey pine, and on the mesa east of Del Monte in the chaparral. It exhibits habits exactly similar to *Arctostaphylos glandulosa* and forms heavy root-crowns. These Monterey shrubs do not seem to be specifically, although they may be varietally, different from the shrubs of Mt. Tamalpais, which are taken as *Arctostaphylos glandulosa.*

Arctostaphylos tomentosa. This species is well developed along the Washington and Oregon coasts, and extends southward in typical form to the Mendocino coast. Within the limits of this range it is well characterized by the long, somewhat scattered bristles of its branchlets, in addition to a fine tomentum, which is rather close and dense. It also occurs in Marin County, especially about Point Reyes, and in the Santa Cruz Mountains, but within this portion of its distribution—that is at its southern limits—it becomes difficult to distinguish from *Arctostaphylos glandulosa.* There is however a fundamental difference between the typical forms that, so far as observed, is invariable—namely, as to their reaction to fire. *Arctostaphylos tomentosa* on the Mendocino coast is quite killed by fire,

PL. II.

A.—ARCTOSTAPHYLOS GLANDULOSA

B.—ARCTOSTAPHYLOS NUMMULARIA

and, so far as observed, reproduces entirely by seed. Mr. W. C. Mathews, one of my students, who has also observed it on the coast region of Mendocino, has given me the results of identical observations on this species. *Arctostaphylos glandulosa,* on the other hand, as noted above, flourishes under fire, and establishes heavy subhypogeous platforms from which sprouts freely rise after fire.

FIG. 2.

Arctostaphylos nummularia is another coast species. (Fig. 3.) It is very erect, with the branchlets crowded with small round leaves. While locally abundant, and even gregarious (Fig. 4), it is in general a rather rare species, and my observation of its behavior on Mt. Tamalpais shows it to be killed outright by fire. (Pl. II, B.) One of my former students, Miss C. M. Hoak, makes a similar observation for the Mendocino White Plains. It may be that the restricted occurrence of this species is due to its inability to respond vegetatively from the root after chaparral fires, a fact which may perhaps be connected with the character of its root-system, which is spread out near the surface of the ground like an inverted umbrella. In any event, the roots lie so near the surface of the ground that they must suffer directly from the heat of chaparral fires (Fig. 5.)

Arctostaphylos stanfordiana is a species of the Mt. St. Helena range. It is remarkable for its deep-green glabrous leaves, and clean, trim habit, and is susceptible of field recognition in this way by those who notice manzanitas. This species, according to the available evidence, does not reproduce vegetatively. This testimony I had first from Mr. Carl Purdy, who lives in its region, and Miss

Hoak, on her own initiative has confirmed this observation, although further field notes on this species are desired. I have seen it many times in the field, but never where the fire evidence was very clear.

Fig. 3.

Arctostaphylos patula is the common species of the main coniferous belt in the Sierra Nevada from the south to the north, and west to Mt. Shasta and Trinity Summit. It is a shrub four to six feet high, and is remarkable for its rather dark but lively green and shining foliage. Under fire killing of its crown, or even apparently in advance of such killing, this species forms a turnip-shaped or globose root-crown that continues to increase in thickness and persistently sprouts under the successive conflagrations that run through the chaparral. Winter snowfall is heavy in this region. Its branches in consequence often lie along the ground, at least as to their lower part, and so take root. Spreading of the species in a given area may occur only in this way—that is, by the rooting of ascending or horizontally spreading branches.

Just here I may revert for a moment to *Arctostaphylos stanfordiana*. In the character of its branchlets, and in its inflorescence, this species is so similar to *Arctostaphylos patula* that the two can scarcely, it would seem, be held as distinct, or in any event it is plain that they lack sufficient differentia. Their difference in behavior under fire, however, helps to make good this lack of technical distinction.

Arctostaphylos manzanita, as to regeneration, is one of the vaguest of the earlier published species with which we have to deal. As to its reaction to fire, a definite report is not yet ready.

Arctostaphylos viscida grows in the Sierra Nevada foothills. The southern form of it has very viscid berries, and is known as *Arctostaphylos mariposa*. Without for the moment going into the matter of the exact status of *A. mariposa*, one may safely say that this white manzanita of the Sierra foothills is in hue the most sharply defined manzanita in California. Its foliage is very glaucous, or even quite silvery, and presents a most striking yet most pleasing contrast to the deep-red bark. My experience is that this species is killed under fire, an observation which has ample confirmation from the experience of settlers in the southern Sierra Nevada in clearing land of chaparral. In an area where, as the saying is, "everything sprouts," they have noticed that this white manzanita does not do so. Mr. Ralph Hopping, Insect-control Expert of the United States Forest Service, also confirms the non-sprouting of *Arctostaphylos viscida*, or in any event its southern form.

To fix the limit of species of *Arctostaphylos* in California has always been difficult, and those who have studied the genus as it occurs with us have recorded widely divergent judgments as to the number of species that are to be recognized. The discrimination of proposed species, however, by all authors, rested upon differences of pubescence, glandulosity and habit. The character of the nutlets and their degree of separation or coalescence has also been used,

FIG. 4.

but is, on the whole, so variable that only slight importance can be attached to it, except in one or two species.

Search for technical characters for the separation of species has been carried on by the writer, but has been to a large degree unsatisfactory in results. Experience, both in field and in herbarium, determines that habit, general aspect, and hue must be taken as of first importance in segregation, although pubescence and glandulosity would have practical value in the construction of diagnoses. Now, if the Californian species be segregated on this basis, one obtains about twenty species. These species, I may say, fall into five or six fairly natural groups, the species in each group being very closely related. In successive attempts to determine the most satisfactory criteria for separating the species within each group, all possible information regarding the life history was sought. As a result, it was found that within the limits of a group the differential mortality of two species very closely related is markedly decisive. As this cleavage is largely between closely related species rather than between groups, the difference in reaction to fire is highly interesting, and is also, evidently, of taxonomic value. In other words, the working conception of species above outlined seems to be unexpectedly fortified by their habits in relation to fire —that is, of root-crown sprouting or of failure to do so.

Fig. 5.

While the number of observations that have been made are not sufficiently large or geographically extensive to warrant final conclusions, the results so far are interesting, and are here put on record to draw out criticism and to stimulate further observations. One set of observations in a given locality, however faithful and accurate, cannot be regarded as entirely sufficient, because in other genera of the chaparral stump-sprouting varies within a species. This variation may be related to the age, vitality, soil situation of the individual, or to some other cause, such as variation in the mutilating or destroying agent, fire or the axe. An excellent example of such variation may be had from *Ceanothus sorediatus. Ceanothus* is a favorable genus for comparison in the matter of stump-sprouting, as many of its species are typical chaparral shrubs, In the Oakland Hills *Ceanothus sorediatus* (Jim brush) has been observed to stump-sprout freely; on Mt. Tamalpais we have found it killed outright by fire. While this difference in behavior in a single species has thus far not been observed in any species of manzanita, ampler records based on a wider range of observations, are desired.

INTERNATIONAL PHYTOGEOGRAPHIC EXCURSION, MARIPOSA BIG TREES.

Seated, left to right: Professor C. von Tubeuf; Mr. A. G. Tansley; Professor W. L. Jepson; Dr. George D. Fuller; Dr. Eduard Rübel, slightly in rear; Dr. Ove Paulsen. Standing, left to right: Mrs. A. G. Tansley; Dr. George E. Nichols; Frau Dr. Brockmann-Jerosch; Dr. Brockmann-Jerosch (slightly in rear with hat); Professor H. C. Cowles; Professor Carl Schröter (with full beard); Professor Adolf Engler (with white waistcoat); Professor F. E. Clements (with book); Mrs. F. E. Clements; Dr. A. Dachnowski (above Professor Clements); Dr. T. J. Stomps (above Mrs. Clements); Dr. Carl Skottsberg, Upsala (left hand raised); Professor H. M. Hall (right rear of Dr. Skottsberg).

THE INTERNATIONAL PHYTOGEOGRAPHIC EXCURSION IN CALIFORNIA.

The first International Phytogeographic Excursion was conducted through the British Isles by the British Vegetation Committee in August, 1911. It was so successful that arrangements were made by Professor Cowles of Chicago for a similar excursion in the United States, in order to observe the more important vegetation areas in general, and to visit special localities under the leadership of American botanists whose studies have given such localities a classical interest.

After spending several weeks in the eastern United States, the Rocky Mountains, Washington, and Oregon, the party arrived in California on September 6th. It consisted of the following members: Dr. H. Brockmann-Jerosch, Zurich; Frau Dr. Brockmann-Jerosch, Zurich; Dr. Geo. E. Nichols, Yale University; Dr. Ove Paulsen, Copenhagen; Dr. Eduard Rübel, Zurich; Professor Carl Schröter, Zurich; Professor C. von Tubeuf, University of Munich; Dr. T. J. Stomps, Amsterdam; Mr. A. G. Tansley, University of Cambridge, England; Mrs. A. G. Tansley, Cambridge; Professor Adolf Engler, Royal Botanic Garden, Berlin; Professor H. C. Cowles, University of Chicago; Dr. A. Dachnowski, Columbus; Mr. Geo. D. Fuller, University of Chicago; Professor F. E. Clements, University of Minnesota; Mrs. F. E. Clements, University of Minnesota.

The party arrived in Oakland on the morning of September 7th, and immediately left for the Yosemite Valley and the Big Trees, under the leadership of Professor W. L. Jepson and Professor H. M. Hall of the University of California. The characteristic foothill flora of the Sierra Nevada was observed from the train windows. After a three-hour stop in Yosemite, the party went directly on to the Mariposa Big Tree Grove. An entire day was spent in the Upper and Lower groves examining the most magnificent examples of *Sequoia gigantea* and studying the vegetative carpet and shrubs of the forest floor. Thence the party proceeded to Glacier Point above Yosemite, with several stops on the way to inspect the Red Fir forest and the associated species. The herbaceous species of the granite were studied to advantage on the top of Sentinel Dome, and the chaparral of high altitudes, at 7,000 to 8,500 feet, came in for attention.

The party made the return trip through the entire length of Yosemite Valley by the way of Vernal and Nevada falls and returned to San Francisco. Local excursions were made to Mt.Tamalpais under the leadership of Miss Alice Eastwood, and to Stanford University under the leadership of Professor D. H. Campbell. At Redwood City the party observed a salt marsh and its vegetation

under the leadership of Professor J. G. Pierce of Stanford University. The party next proceeded to Monterey, in order to examine the remarkable tree island of the Monterey Peninsula, under the leadership of Professor L. R. Abrams of Stanford University, and of the chaparral under the guidance of Dr. W. S. Cooper. For studies of the marine algae of the Monterey coast, parties were led by Professor W. A. Setchell of the University of California. From Monterey the excursion proceeded to Arizona, stopping off at Mecca, in the Colorado Desert of California, for examination of the desert flora, on a trip along the borders of the Salton Sea under the direction of Dr. D. T. MacDougal of the Carnegie Desert Laboratory, and Mr. S. B. Parish of San Bernardino.

W. L. Jepson.

Dinner to the International Phytogeographic Excursion.

The members of the Phytogeographic Excursion were entertained at dinner by the California Botanical Society at the Hotel Oakland on the evening of Friday, September 12th, 1913. Professor Jepson, President of the Society, presided.

The President: Members of the Botanical Society and honored guests: We are met here at dinner to greet fraternally the members of the Second International Phytogeographic Excursion and give them a welcome to California. Just now the party is fresh from the scenes of the Yosemite and Mariposa Big Trees, laden with botanical spoils, and covered impartially with the dust of the San Joaquin. We Californians, who have had the great privilege of traveling with them, have had a delightful experience. These visitors to California have been most appreciative of what we have had to show. They have stepped blithely from dome to dome about Yosemite, happily content that there was no danger, as amongst the sharp-pointed Alps at home, of slivering a mountain peak in one's foot. Without mar or accident, all has gone well. The great quest in the Sierras was, to be sure, the Big Trees. We knew in advance that they would desire to have cones of *Sequoia gigantea*. As it is inconvenient to pick from the tops of the trees, we arranged the matter with Mr. Zeus, a Greek citizen, and coworker with Mr. Franklin and Mr. Farraday, to strike gently the top of one of the trees with his bolt. So the party found on the ground about the Indiana tree branchlets and cones neatly arranged for their inspection—and collection. One of the party regretted that the azaleas along the Merced were not in flower. This was an oversight which we lament, as we should have had them properly etherized. But in any event the party was extremely appreciative of our humble efforts in their behalf.

This is the first party of botanists to come to California as an organized excursion. Thirty-six years ago a small party, consisting of the botanists Sir Joseph Hooker and Asa Gray, and a geologist, Director Hayden of the Geological Survey, visited California, and were entertained by the California Academy of Sciences. Their coming was an event long remembered by California botanists. Since that time many new schools of morphology, of physiology, and other branches of botany have come into prominence, schools which in the main deal exclusively with the plant or plant parts under control—in the laboratory, the greenhouse, or under the compound microscope. But now there arises a school of botanists, the plant ecologists, who are leading us back to the fields and woods, taking with them the experience of all other schools, and in addition making important use of the observations of the old-time naturalists. California is a glorious field for such work, and we welcome them here to help us appreciate our own flora, and to help Californians to an appreciation of it. In this welcome I ask my colleague, Professor Setchell, to join me.

Professor Setchell spoke a few words of cordial welcome to the visiting botanists, both those of foreign countries and of our own, who had journeyed so far and seen so many wonderful things. He bade them welcome on behalf of the botanical department of the University of California, and on his own behalf, and wished them the greatest success in their further studies in this state and in adjacent states, and expressed the hope that the remainder of their journey might be even more pleasant than its preceding stages.

The President: "We have in our company tonight a zoologist who has made for himself a celebrated name in geographical problems in America, and whose distributional work with both plants and animals is known everywhere. I take pleasure in introducing Dr. C. Hart Merriam, long time Chief of the United States Geological Survey."

Dr. Merriam echoed the expressions of welcome already made, and spoke of the special interest that California has for the naturalist from the great diversity of conditions of soil and climate within comparatively small areas.

The President: "It is always pleasant to botanists to know that those who sit in the seats of the mighty are friendly to their cause. Most people imagine that the present Acting President of the University of California is most celebrated for his achievements in the Philippines, but there are those of us who know that his claims to fame belong elsewhere. In his earlier youth he completed a piece of work on "The Ethno-Botany of the Coahuilla Indians." It is for this that we botanists claim him. I take great pleasure in introducing Dr. David P. Barrows."

Dr. Barrows: "Mr. President, Ladies and Gentlemen: The work on botany mentioned by the Chairman, I had almost forgotten

as a botanical subject, because that feature was only incidental to the study of ethnology in which I was engaged for the ten years from 1890 to 1900. But my interest in botany was aroused by the study, and was strengthened by my observations of the botanical gardens at Buitenzorg, Java, which are probably the most famous in the world, the only rival being the Kew Gardens in London. The plants in this garden are of a wonderful variety, possible because of the tropical climate and abundant moisture. The gardens stand without peer in the studied care with which they are laid out and kept, and in the wonderful luxuriance of growth and the vivid coloring of the flowers. Everything from all the world seems to thrive. Recalling the splendor of these gardens, I have often asked myself why could not the botanical public of California establish even such gardens at our own University; for there we have ample space in the rolling hills beyond the campus, which could be laid out in most picturesque effects.

"The climate of California lends itself to the cultivation of floras of many types because of its mildness; and the variation from the moisture of winter months to the dryness of the summer season gives suitable conditions for plants of a great difference of habit. The soil of the Berkeley Hills is also variable, and would therefore accommodate many species. The fact that the University Hills are higher than the surrounding country would add greatly to the facility of building up gardens, and to the charm that would invest them when completed. If we had such a place at our University it would be a powerful factor, as added to the natural attractions of the state, in enlisting the interest of botanists and flower lovers in the Pacific Coast and in California."

The President: "The organizer of the International Phytogeographic Excursion in America is one of our country's most famous ecologists. He belongs to the 'Middle West,' but he has learned since reaching California that he is from the 'East.' I will now call upon Dr. Cowles, Professor of Plant Ecology in the University of Chicago."

"Mr. President: It has been a delightful pleasure to us to journey through this region, and enjoy the wonderful vegetation and the hospitality of California. Once, many years ago, I came to this Golden State and luxuriated in golden days. I have happy memories of that time. Now that I am come back to it I find your dust of the San Joaquin as sweet as the peaches of Sonoma, the hot air of the foothills as intoxicating as if wafted from Araby the Blest. Our work has been successful far beyond our expectations. We are deeply indebted to you for your aid, and I thank you on behalf of the whole party."

The President: "The great quest of the plant geographers to California was undoubtedly the Big Trees. One of the European botanists said to me: 'I have looked forward all my life to seeing

these great trees. I shall make one journey to them; shall see them only once.' We shall now hear with very great interest from Professor Tubeuf of the University of Munich."

"Ladies and Gentlemen: The uniqueness of this occasion has impressed me more and more during the course of this dinner. Nowhere on our long journey have we been received with such magnificent, not to say princely, hospitality. And the ladies here, fair as your skies, rosy as your wine—nowhere else have ladies and wine added so memorable a feature to American hospitality. The Hebrews have a proverb to the effect that one ought 'not to muzzle the ox that treadeth out the corn.' You follow it to the letter. You even insist that he shall open his mouth, whatever be the result.

"You will, I hope, not take it amiss that I speak in my native tongue. In German I am on firm ground. In English I am liable to get stuck in a swamp of words. Among your accomplishments you doubtless reckon this also, that you have a botanist's familiarity with flowers of speech—even German ones. I am speaking for my colleagues as well as for myself when I say that we are intensely interested in the extremely diversified flora of California.

"When a lad I read in the geographies of your high mountains, wonderful trees, and fields of glorious bloom. It was the dream of my youth to see this paradise. Now in the evening of life I come, with my colleagues. We are not disappointed, we are astonished; what we find is finer than any dream. Your ancient trees seen in all their living splendor are far beyond what any picture can convey. And as we stood looking up at one of the giant Sequoias a creature flew about nearby. Everything you had shown us was on such a grand scale, I said, 'this must be a California butterfly.' It alighted; and behold, it was no butterfly but a bird, a hummingbird. How most remarkable, at the same moment, to see the smallest of birds and the greatest of trees!

"And not less interesting than your flora is the freedom, the abandon, the largeness, the youth, of your Western life. It is extremely gratifying to find amid this absorbing material development of your civilization that interest in scientific pursuits to which this dinner, this Society, and this splendid occasion testify. It is truly American—may I say Californian?—that town and gown unite in cherishing and promoting this interest in the wonderful world of plants. Let me assure you that this will remain a memorable occasion with us all, and we hope the California Botanical Society will live to the age and dignity of your mighty Sequoias."

The President: "We have here in California no botanical garden which may be truly called such; nor have we any great arboretum, although we have the finest of all natural coniferous woodlands in the world. As we have just returned from the *Sequoia gigantea* groves, it is fitting that the foremost of living botanists should say a word in regard to the greatest of all trees. I now have

the especial honor of presenting to you Dr. Adolf Engler, Professor of Botany and Director of the Royal Botanical Gardens at Berlin."

"Mr. President, Ladies and Gentlemen of the California Botanical Society: My English is limited, and I find it difficult to express appreciation of your courtesy to us. But for my friends and myself I thank you for the welcome conveyed in this table spread with choice food and rare wine, in the beautiful flowers all about us, and most of all in the presence of the charming ladies of your charming State.

"We have seen wonderful things in California and are well repaid for the arduous days of our journey. We have just arrived from the Yosemite Valley and the Mariposa Grove of Big Trees. The Yosemite is truly wonderful. But what can I say of the Big Trees? The impression made upon my mind by the *Sequoia gigantea* will never die within me. The fine trees in the Mariposa Grove excited the loftiest feelings. I bared my head before them. I walked around them. I placed my hand reverently on their trunks, for they are the great wonders of the plant kingdom.

"And now we come to your cities and are met on all sides by the growth of your civilization. But it seems that you have no great botanic garden in California, and this is noticeable because there are few more favorable places in the world than this for a great botanic garden. It would be a task of pure joy to bring plants and trees from all parts of California that your own people, as well as travelers, might observe and study your flora in a compact view. Moreover, you would wish to bring desirable plants from the limits of the earth and teach the strangers to thrive in their new home. It is a magnificent project and you Americans could carry it along magnificently.

"But I hear it said you have no money. Ah, that is no worthy answer! And how can that be? I see on every side the signs of great wealth. You have money for what you call skyscrapers—money for palaces and cities. It would be a disgrace to say you had no money for botanical science, for one of the important things to the state must be a botanic garden. As you know, nearly every important city in Europe has its botanic garden. I make a plea to you who are so greatly favored by nature to add to what nature has done, and to build for yourselves and for the whole world a treasure spot, which shall have living, growing plants from all California and from the far corners of the earth. I desire to see a great botanic garden in California because a great botanic garden is very near my heart. Such a collection as I picture would enrich the whole botanical world and would be forever an honor to you its builders."

After the dinner the party adjourned to the ballroom of the hotel where an illustrated lecture on the flora of the Alps was given by Professor Schröter.

PISTILLODY OF THE PERIANTH IN TRILLIUM SESSILE.

T. H. Goodspeed.

During the latter part of March, 1914, a considerable collection of the familiar *Trillium sessile,* var. *giganteum* H. & A., was found at the lower end of a small heavily shaded canyon in the Oakland Hills. Approximately sixty plants were in flower and an equal number of plants bore no flowers, or flowers exceedingly rudimentary in character. The mature flowers, with one exception, were all of them normally developed, and varied in color from a light violet to deep garnet. One plant, which in no way stood out from the rest by reason of any unusual vegetative development, at once attracted attention because of the abnormal flower which it bore. In this flower both corolla and calyx were green and fleshy; the color and texture of the six perianth segments being that which is ordinarily characteristic of the calyx of *Trillium.* These six similar segments were arranged in two whorls of three parts each. The outer whorl, representing the calyx, was characteristic in shape and size, while the inner whorl, representing modified petals, corresponded in shape to the calyx segments, but were somewhat shorter. They also exhibited a peculiar curling-in of their lower margins to form slender tubes, which extended for a distance of from 4 to 11 mm. up from their point of attachment on the receptacle. When the curled edges were rolled back the interior of the tubes that they formed were found to contain a number of small greenish-white bodies attached near the margins. The number was variable on the two curled edges of the same segment, and one modified petal bore only three, which were along one edge only.

The color and general appearance of these protuberances on the margins of the calyx-like petals suggested that they represented ovules. This supposition was to a certain extent confirmed by the fact that the flower contained only a minute rudimentary pistil, within which no structures resembling ovules were found. It is almost the rule that *Trillium sessile,* var. *giganteum* in the San Francisco Bay region produces no seed, or very little seed, but in the normal open flowers the ovary will uniformly show maturing ovules or unmistakable traces of them. (Fig. 6.)

The attached photograph was made two days after the abnormal flower had been collected, and in consequence the flower parts are somewhat withered. Three of the ovule-like bodies are discernible along the folded-back margin of one of the modified petals. By reason of their greenish-white color, they stood out very strikingly in the flower against the dark-green background. As can be seen, the stamens, normally pollen-bearing apparently, are present. The stamens were in no way abnormal.

The drawings represent in both cases sections of material imbedded in paraffin and cut 15 microns thick. (Fig. 7a.)

Fig 6. Teratological flower of *T. sessile,* var. *giganteum* H. & A. Three ovules can be seen, at the head of the arrow, borne along the margin of a modified petal.

In the upper drawing is shown a portion of the cross-section of a normally produced ovary of *Trillium,* to show the appearance and structure of the ovules. (Fig. 7b.)

The lower drawing represents a cross-section of one of the modified petals found in the abnormal flower shown in the photograph and described above. This lower drawing is partially reconstruction, since no two ovules on opposite edges of the same modified petal gave exactly similar views in any one section. In both drawings only cell outlines are shown, since the tissue of the abnormal flower was not prepared for sectioning until some days after its collection, and the contents of the cells had, to some extent, degenerated.

As shown in these drawings, the similarity between the structures borne normally within the ovary attached to the placenta and those present along the margins of perianth segments is striking. There seems to be no room for doubt that we are dealing here with a case of pistillody in which the perianth segments of the flower are concerned; that is to say, three segments of the six-parted perianth bear ovules, and thus function in a sense as pistils or better as carpels. It is evident that if these three modified petals were first folded to bring their ovule-bearing margins together and thru all three united along these double edges, a three-celled or three-carpelled structure would be produced that would correspond exactly to

the normal three-celled ovary of *Trillium*. Such pistillody of the perianth is an abnormality of much less common occurrence than a similar modification of the stamens. Masters,[1] however, describes and illustrates a case of pistillody of the perianth in *Tulipa gesneriana*

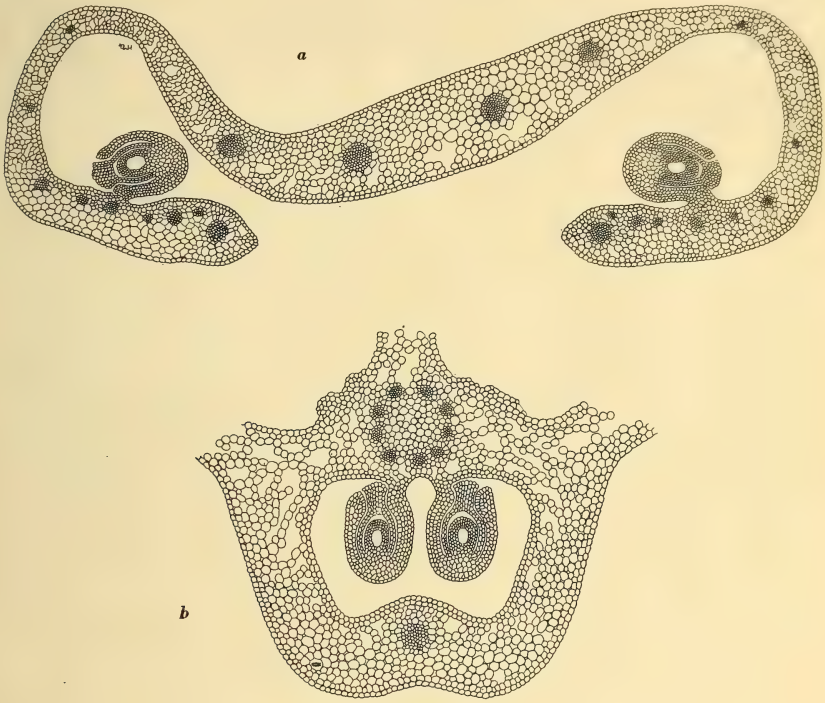

FIG. 7.

(a) Cross-section through a normally produced and matured ovary of *Trillium sessile*, var. *giganteum* H. & A. The section is taken across the top of the ovary, and the ovules are seen attached to the placental surfaces, which have here grown together to form a seemingly axial placenta. Diagrammatic.

(b) Cross-section through one of the modified petals of the teratological flower of *T. sessile*, var. *giganteum*. Ovules are here found attached, free, along the margins of a perianth segment.

that strikingly resembles the conditions present in this abnormal flower of *Trillium*. It is to be noted that the ovule-bearing perianth segments of this *Trillium* showed no evidences of any such further modification of their margins to form stigmatic or stylar surfaces,

as in the case of *Crocus nudiflorus* mentioned by Masters,[2] and quite often the rule in cases of pistillody of the stamens.

The occurrence of floral and vegetative abnormalities in both Eastern and Western species of the genus *Trillium* is frequently mentioned in the literature on the subject. The most complete description and illustration of such abnormalities is that of Britcher,[3] in the case of the Eastern *T. grandiflorum,* which the Californian *T. ovatum,* with its pedunculate flowers, resembles. Appended is a partial list of references to the literature dealing with teratology in the genus *Trillium* which may be of interest, as indicating the range of its possible floral and vegetative abnormalities.

This brief note on pistillody in *Trillium sessile,* var. *giganteum,* is presented both for the sake of putting upon record this somewhat unusual floral abnormality, and also in the hope that it may call the attention of the members of the California Botanical Society to what may be a new, and to what cannot fail to be an interesting, objective on their botanical expeditions. There is distinct scientific value in a thorough knowledge and catalogue of cases of teratology exhibited by the California flora, and such knowledge must be accumulated concurrently with the extension of systematic studies throughout the native flora. The California Botanical Society might entertain the suggestion that a secondary aim of their expeditions be the collection of all significant floral and vegetative abnormalities for the herbarium, while this journal might establish a section devoted to the recording of the most interesting cases of teratology.

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[1] Masters, M. T., "Vegetable Teratology," London, 1869.
[2] Op. cit., p. 302.
[3] Britcher, H. W., "Variation in Trillium grandiflorum," Maine Agric. Expt. Stat., Bull. 86, Nov., 1902.

CALENDAR OF MEETINGS.

April 26, 1913.—Meeting to perfect permanent organization. (I) A draft of the constitution and by-laws was discussed and referred to a committee for further study. The following officers, provisionally elected at the first meeting, were ratified, with the exception of Miss Tyrrell who resigned, Miss Beans being elected to fill the vacancy: President, Dr. W. L. Jepson; First Vice-President, Mr. Guy Smith; Second Vice-President, Dr. W. F. Badè; Secretary-Treasurer, Mrs. D. W. de Veer; Corresponding Secretary, Miss Rowena Beans. (II) Brief talk by Dr. Jepson on "The Chaparral of California."

September 12, 1913.—Regular meeting at Hotel Oakland. Lecture by Prof. Dr. Carl Schröter of Zurich, Switzerland, on "The Flora of the Alps." Illustrated by stereopticon views.

October 14, 1913.—Business meeting. Reports of all Committees, and informal discussion of plans for the year.

November 8, 1913.—Regular meeting. Talk on "The Wild Flowers of California," by Mrs. C. E. Cunningham, of Antioch. Display of water-color paintings of several hundred species of native plants.

December 13, 1913.—Regular meeting. Lecture by Dr. E. P. Meinecke, Forest Pathologist of the United States Bureau of Forestry, on "Forest Trees and their Diseases." Illustrated by stereopticon views.

March 21, 1914.—Special meeting. Report of Nominating Committee. Discussion on methods of care and preservation of herbarium specimens and recording of field observations.

April 18, 1914.—Annual meeting at California Academy of Sciences, San Francisco. Election of Officers. Lecture by Mr. Carl Purdy of Ukiah, on "Bulbous Plants." Illustrated by specimens.

September 26, 1914.—Regular meeting. Lecture by Mr. C. B. Bradley on "Observations Concerning the Life and Habits of Sequoia gigantea."

October 3, 1914.—Special meeting. Lecture by Dr. W. L. Jepson on "Manzanitas." Illustrated by stereopticon views.

October 10, 1914.—Regular meeting. Lecture by Dr. H. M. Hall on "Plant Ecology." Illustrated by stereopticon views, and specimens from the exhibition of ecological formations then in progress.

November 14, 1914.—Regular meeting. Lecture by Dr. P. B. Kennedy on "Observations on Certain of the Native Clovers." Illustrated by herbarium specimens and drawings.

December 12, 1914.—Annual dinner at Hotel Carlton, Berkeley. Talk by Mr. S. B. Parish of San Bernardino, on "Reminiscences of Early Days and Early Botanists of California."

January 16, 1915.—Regular meeting. Lecture by Miss A. M. Lute, Seed Expert of the United States Department of Agriculture, on "Taxonomic Values in Seeds." Illustrated by stereopticon views.

REPORT OF FIELD TRIPS.

May 10, 1913.—Leader, Mr. Guy Smith. Locality, San Leandro Hills and the Lake Chabot district. The trip was meant as one of general observation.

Brodiaea congesta (Ookow) was found in abundance in full flower in a field of half-grown grain. The bulbs are too deep-seated to be disturbed by the plow, and, their season of growth coming after the seeding of the grain, they are benefited rather than injured by cultivation.

Papaver heterophyllum (Wind Poppy) and *Calochortus albus* (White Globe-Tulip) were found on a rocky hillside. In one canyon *Mimulus langsdorffii,* var. *grandis* (Monkey-flower), grew in profusion.

May 31, 1913.—Leader, Dr. W. L. Jepson. Locality, Leona Heights, Oakland. Especial attention was paid to the condition of plants under extreme drought, which was then in its third season, causing summer flowers to exhibit all evidences of hardship in prolonging their existence.

Adenostoma fasciculatum (Chamisal) served as a text for a discussion of habits of the shrubs which inhabit dry hillsides.

January 10, 1914.—Leader, Dr. W. L. Jepson. Locality, Telegraph Canyon, Berkeley. The object of the trip was the study of seedlings. The characteristic growth of several species was observed. *Lupinus densiflorus* (White or yellow Lupine) proved the most interesting in its habit of protecting the young plumule inside the swollen upper stem until sufficient development is made to withstand the frosts that threaten in December and early in January, when the plants are beginning to grow.,

February 14, 1914.—Leader, Mr. Frank B. Kellogg. Locality, the sand-dunes south of the Cliff House in San Francisco. Mr. Kellogg explained the special characteristics of dune-binding plants, their extremely well-developed underground parts, both roots and subterranean stems, and their habitual low and

tufted or spreading growth. It was demonstrated how terminal growth is prevented on shrubs and trees exposed to much wind, while lateral twigs develop more fully, producing the one-sided effect seen in the woody plants on coasts or hills facing the sea.

The species observed most closely were *Ammophila arenaria* (Beach Grass or Arram Grass), *Elymus arenarius* (Sea Lyme Grass), *Lupinus arboreus* (Tree Lupine), *Abronia latifolia* (Yellow Sand Verbena), and *Cupressus macrocarpus* (Monterey cypress).

February 28, 1914.—Leader, Miss Harriet Walker. Locality, Land's End, San Francisco. An observation of the permanent growth that can be found on the seaward cliffs was made. The grasses *Ammophila* (Beach-Grass) and *Elymus* (Wild Rye) and a sturdy *Equisetum* (Horsetail Rush) bind the shifting sand, and *Salix lasiolepis* (Arroyo Willow) is fixed on the banks. At this date *Fragaria chilensis* (Sand Strawberry), *Sanicula arctopoides* (Snake Root) and *Dentaria integrifolia* (Milkmaids) were in full bloom; while belated blossoms of last year's *Grindelia* (Gum Plant) and *Eriophyllum staechadifolium* (Lizard Tail) were to be seen.

March 14, 1914.—Leader, Mrs. Guy Smith. San Bruno Hills were visited for the study of *Iris longipetala.* Hundreds of acres are covered with this species.

March 28, 1914.—Leader, Mr. L. S. Smith. Locality, Mt. Tamalpais. Two characteristic associations were observed, the chaparral and the redwood floor. In the former two or three species of *Ceanothus* (Mountain Lilac) and *Arctostaphylos* were found in blossom; while along the trails and open spots many liliaceous plants and annuals were in flower. On the redwood slopes *Vancouveria* and *Oxalis oregona* were found.

EXHIBITS.

Autumn Exhibit of Native Flowering Plants.

From October 13 to 17, 1913, the Society held an exhibit of flowering plants at the Oakland Public Museum. A committee, of which Mr. Guy Smith of San Leandro acted as chairman, made a collection of about 300 species—219 in flower, and others in fruit. Most of them were taken from the Bay region, but some were sent from Plumas, El Dorado and Amador counties, the Yosemite, and the desert of San Bernardino County.

(Calendar of meetings, field trips and exhibits to be continued.)

FIELD OBSERVATIONS.

New Station Reported for Bellardia trixago (Lousewort).—In April, 1914, this plant was flowering in abundance on a small plot of land in East Oakland, where the soil had been disturbed a few years ago by deep cutting of street grades. It was called to the attention of the Botanical Society through specimens collected by school girls. The plant was not observed elsewhere in the vicinity. —D. W. de Veer.

Utilization of a New Host by Aphyllon uniflorum (Cancer-root).—In April while watering some *Sedum spathulifolium* that had been transplanted to my garden, I found some dark-blue flowers growing among them. Examination of the pale leafless plants showed them to be *Aphyllon uniflorum* (Fig. 11), parasitic upon the roots of the *Sedum.* After this observation I went to the cliff on the side of Twin Peaks, from where the *Sedum* had been procured. There I found the *Aphyllon* associated only with *Sedum,* both on the top of the cliff and on the shaded side. In this connection I might add that only a few weeks before I had found *Aphyllon tuberosum* growing on Manzanita roots on Mount Tamalpais.—M. Alice King.

Fig. 11.

a. Aphyllon uniflorum *b. Sedum spathulifolium*
c. Corolla and stamens
d. Pistil
e. Capsule

White Oenothera ovata (Sun-cups).—On April 8, 1914, six plants of *Oenothera ovata* bearing white flowers were found on the

top of the ridge above Moraga Valley, near Redwood Canyon. They were not very close to other plants of the same species bearing yellow flowers.—Harriet P. Kelley.

The Southernmost Known Station for Viburnum ellipticum.—This plant grows near Sonoma, in the first little canyon to the left when one has passed El Cerrito Ranch, along the road going north between Buena Vista and Sonoma town. It is found two miles higher up along the same road, and has also been found near Sebastopol. In flower it is a very beautiful bush, entirely covered with waxy white flowers in umbels, reminding one very much of the *Laurestinus,* the common evergreen shrub of the gardens. *Viburnum ellipticum* is ten to twelve feet high, with the bark dark on the old stems and light brown on the young branches. These are opposite, and so are the elliptic leaves, which are dentate, or sometimes entire, and deciduous. The fruit is about two lines long and flattish. I have not seen any ripe fruit. My neighbor says it is reddish or brown. This species is flowering in May.—R. Kuhn.

Field Notes From Sonoma County.—Fruits of *Viburnum ellipticum* I have not yet found. My neighbor said that possibly some animal had eaten them. In any event, my attention was called to the forays of ground-squirrels. They collected the seed-pods of *Viola pedunculata* (Yellow Violet), for I found heaps of pods near the hole in the meadow at El Cerrito Ranch, and they must have collected the pods of *Calochortus luteus* (Yellow Mariposa Lily), also. Last year I found *Malus rivularis* (Oregon Crab-apple) along the creek on the road to the Petrified Forest, not far from the Forest, on the Santa Rosa side of the moutains. To-day (May 29, 1914) I found in the mountains near Bismarck Knob a beautiful plant of *Antirrhinum virga* (Snapdragon). Another find of interest I may add: *Bellardia trixago* (Lousewort) grows very profusely along the roads and even in the fields between Sonoma and Napa, mostly east of the boundary-line between Sonoma and Napa counties.—R. Kuhn.

Phellopterus littoralis Schmidt.—In a package of *Umbelliferae* from the North Coast Ranges I find *Phellopterus littoralis,* which is to be recorded as an addition to the flora of California. This species was collected by Mr. Davy, formerly Assistant Botanist of the College of Agriculture, University of California, at Eureka and again at Crescent City. It is a plant of sea-beaches, growing in sandy places on small dunes. The leaves lie prostrate, and in time become more or less covered by wind-driven sand. The umbel, which is about two and one-half inches broad, rests on the sand, is hemispherical in shape, and very compact. The body of the fruit is dorsally flattened, but the five broad wings of each mericarp give to the fruit a subglobobe outline. This species has long been known on the Oregon and Washington Coast, whence it ranges northward and westward to the Asiatic Coast.—W. L. Jepson.

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The California Botanical Society wishes to acknowledge with thanks the generosity of the Oakland Public Museum, in allowing the use of its lecture room for the regular meetings of the Society.

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I, ..., do hereby give and bequeath to the California Botanical Society the sum of ..... dollars, and I direct that the said sum be invested by said Society and the income thereof be used for.....

VOLUME I NUMBER 2

MADROÑO

Journal of

THE
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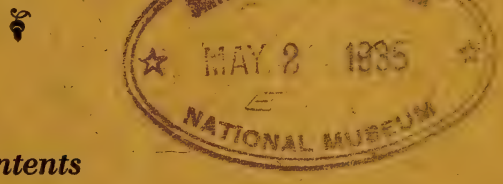

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[*Issued April 13, 1917*]

MADROÑO

JOURNAL OF THE CALIFORNIA BOTANICAL SOCIETY

The purpose of the Journal is, primarily, to publish non-technical articles and notes on the natural history of the native and exotic plants of California; to furnish a medium of communication relating to measures in behalf of the preservation of the native flora; and to provide a record of the Society's meetings and activities. Notes upon the habits, life-history or occurrence of native plants, or records of cultural experiments will be especially welcome for publication.

The Journal is published at irregular intervals: Vol. 1, No. 1, 50 cents; Vol. 1, No. 2, 50 cents. For copies of the Journal and for information relating to the Society, address

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THE FLORA OF THE SWISS ALPS[1]

Dr. C. Schröter

Professor in the National Technical School, Zurich, Switzerland.

I.

The extensive range of the European Alps forms an arch covering a distance of 750 miles from Genoa to Vienna. It comprises a series of folds of geologically recent formation; it dates from the beginning of the Tertiary period. The Swiss Alps occupy almost the center of the arch. The divisions of the Swiss Alps in horizontal regions are determined, first, by the geological nature of the soil, and, secondly, by the climate. If we glance at a geological map of the Alpine range showing a few outlines, we perceive a center of primitive siliceous rocks, the Central Alps. This center is bordered on the south and on the north by a fringe of calcareous sediments, first of Mesozoic, then, toward its margin, of Tertiary age. The Prealps are therefore formed principally by calcareous soils, nourishing a calciphilous vegetation; the Central Alps consist of siliceous rocks, occupied by a limestone-avoiding flora.

In addition to this geological difference between Central Alps and Prealps, we have a climatical one in this sense, that the Prealps show a more oceanic climate with mitigated extremes, the Central Alps are more continental with pronounced extremes. This accounts for the fact that the two trees of continental character, the Larch (*Larix decidua* Mill.)[2] and the Stone or Arolla Pine (*Pinus cembra* L.), are confined to the Central Alps.

A third difference between Prealps and Central Alps is accounted for by the difference in altitude of the upper limit of the growth of trees and of the under limit of eternal snow. It is a general law that in great mountain masses all limits are found at a higher level than in isolated chains. (This is clearly indicated by the picture showing the situation of the snow-line in the different parts of Switzerland. All the points with identical altitude are joined by a black line, called an isochion.) In the region of the northern Prealps the snow-line lies at 8,000 feet, and toward the Central Alps it rises higher and higher; in the Engadine Alps it is situated at 9,300 to 9,600 feet, in the great masses of the Pennine Alps (Monterosa) even at 10,000 feet. Similar differences show the upper limit of tree-growth, and in general all the limits of plant life.

From this fact, combined with the warm summer and historical causes, originates the great variety of the flora of the Wallis and the Engadine; if you want to spend your holidays in the countries richest in alpine flowers, you are to go to Zermatt or to Pontresina.

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[1] Lecture delivered before the Society, Sept. 12, 1913.

[2] Nomenclature after Schinz and Keller, Flora der Schweiz, 3 ed. 1909.

These are the regional subdivisions of the Alps; in wandering from the Prealps to the Central Alps, we meet first limestone plants, oceanic ones and low limits, then in the Central Alps limestone-avoiding plants, continental ones and high limits. But still more pronounced than these regional differences is the change in vegetation as we ascend toward the mountains from the lowlands. Switzerland, although a small country, contains within its boundaries all the vegetations of Europe from the mild Mediterranean region to Spitzbergen and Lappony! We are able to wander through an extent of thirty degrees of latitude in the course of *one* day, in climbing, for instance, from Siders in the hot valley of Wallis (1,450 ft.) up to the Gornergrat near Zermatt (10,000 ft.). The change in vegetation is extremely gradual, but nevertheless we can divide it into four well-defined zones, or belts.

The first, comprising the Lowlands, extends to the upper limit of the vineyard; above 1,500 or 2,000 feet the grape will not ripen; only in Wallis, in the masses of the Pennine Alps, the vineyards reach up to 4,000 feet.

Then follows the light-green belt of the deciduous forests, the domain of deciduous trees, the mountain belt, or beech belt, surrounding like a garland the foot of the Alps, reaching to about 4,500 to 5,000 feet above the sea.

And now we enter the dark-green coniferous belt, the subalpine belt, where the Spruce (*Picea excelsa* Link), the Larch, and the Arolla Pine form dense woods, reaching upward to the upper limit of tree-growth. Here already alpine conditions of life begin to rule. At 6,000 to 9,000 feet lies the tree limit.

Above this belt begins the true alpine (the treeless) belt, the kingdom of pastures and meadows, of rock, screes, snow and ice. But the plant life has conquered the whole belt and climbs to the highest peaks wherever a place exists free of snow.

The extreme altitude at which a flowering plant has been found in Switzerland is 14,250 feet above the sea-level; it is the glacial buttercup (*Ranunculus glacialis* L.), which ascends to this altitude in the Finsteraarhorn in the Bernese Oberland. Eight species[3] of flowering plants exist above 13,200 feet, more than three hundred in the whole snow-belt above the under limit of perennial snow.

Still more resistant than the higher plants are the cryptogams, especially the lichens; over one hundred kinds of these plants are found above 11,300 feet, and six different kinds[4] cover the top of

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[3] *Ranunculus glacialis* L.; *Achillea atrata* L.; *Androsace alpina* (L.) Lam.; *Saxifraga aspera* L. var. *bryoides* L.; *Sax. moschata* Wulfen; *Sax. muscoides* All.; *Sax. biflora* All.; and *Gentiana brachyphylla* Vill.

[4] *Toninia conglomerata* (Ach.) Zahlbr.; *Rhizocarpon geographicum* (L.) DC.; *Pamelia spec.; Umbilicaria spec.; Lecanora concolor* Ram. var. *angustata* (Arn.) Nyl., with the parasitical lichen *Buellia leptoleptis* Bagl. & Car.

the highest Swiss mountain, the Monte Rosa, at 15,217 feet. There is indeed no real upward limit of vegetation in the Alps.

A short excursion through some characteristic parts of the country will show us the principal steps in the change of the vegetation. We begin in the lake region at the southern foot of the Alps, where we find the mildest climate in Switzerland. At the shores of the lakes of Locarno, Lugano, and Como, the Italian cypress (*Cupressus sempervirens* L.) brings us a greeting from the Mediterranean countries (Fig. 12).

Then we enter the beech forests, and admire the mighty crown of this dominant tree (*Fagus sylvatica* L.) of the mountain belt; the group shown in Figure 13 grows near Flims in the Oberland of Grisons, and is renowned for its luxuriant growth.

From the top of the Piz Mundaun in the same Oberland of Grisons we cast a glance at the slopes of the valley of the Upper-Rhine, where the coniferous belt (*Picea excelsa* Link) is seen in its whole extension, surrounded at its foot by woods of oak, and transgrading upward into the alpine belt (Fig. 14). This dark-green girdle, formerly continuous without any doubt, has been partly destroyed by human action, and shows now many interruptions filled with corn-fields, meadows, and pastures—that is, various culture and semiculture formations.

The Scotch Pine (*Pinus sylvestris* L.) with its flattened crown is the tree of our very poorest soils, where it adorns rocky or sandy slopes, as is shown in our picture taken near the Campodials in the Grisons (Fig. 15).

In the Central Alps, especially in the Upper Engadine and Wallis, the Spruce is upwardly replaced by a tree of the continental climate, the Larch (*Larix decidua* Miller), forming open woods with so slight a shade as to allow the occurrence of a good pasture under the trees. Thus those larchwoods form an ideal solving of one of the most intricate economical problems of the Alps, the cause of an endless conflict between forester and alpine farmer. And at last we admire in the Central Alps, for instance at Zermatt or Engadine, another continental tree, the Arolla Pine, the Siberian Cedar, the king of the alpine trees (*Pinus cembra* L.), which forms often the timber-line (Fig. 16).

And now we reach the limit of tree-growth, this most important biological line, which separates the Arctic region and the alpine belt from milder climates. It is not a line; it is a girdle where the tree struggles for its life (*Kampfzone*, struggle belt). First we leave behind us the continuous wood (Forest-limit), then the isolated pioneers of trees (Tree-limit), and finally the stunted forms of trees (Cripple-limit).

In and above this belt of struggling tree-life lies the belt of alpine shrubs; the Alpenrose (*Rhododendron*), the green Alder (*Alnus viridis* (Chaix) Lam.), and the dwarf Pine (*Pinus montana*

Fig. 12. The Italian Cypress (*Cupressus sempervirens* L. var. *fastigiata*) on the shore of Lake Como near Bellaggio. Photo Taegar.

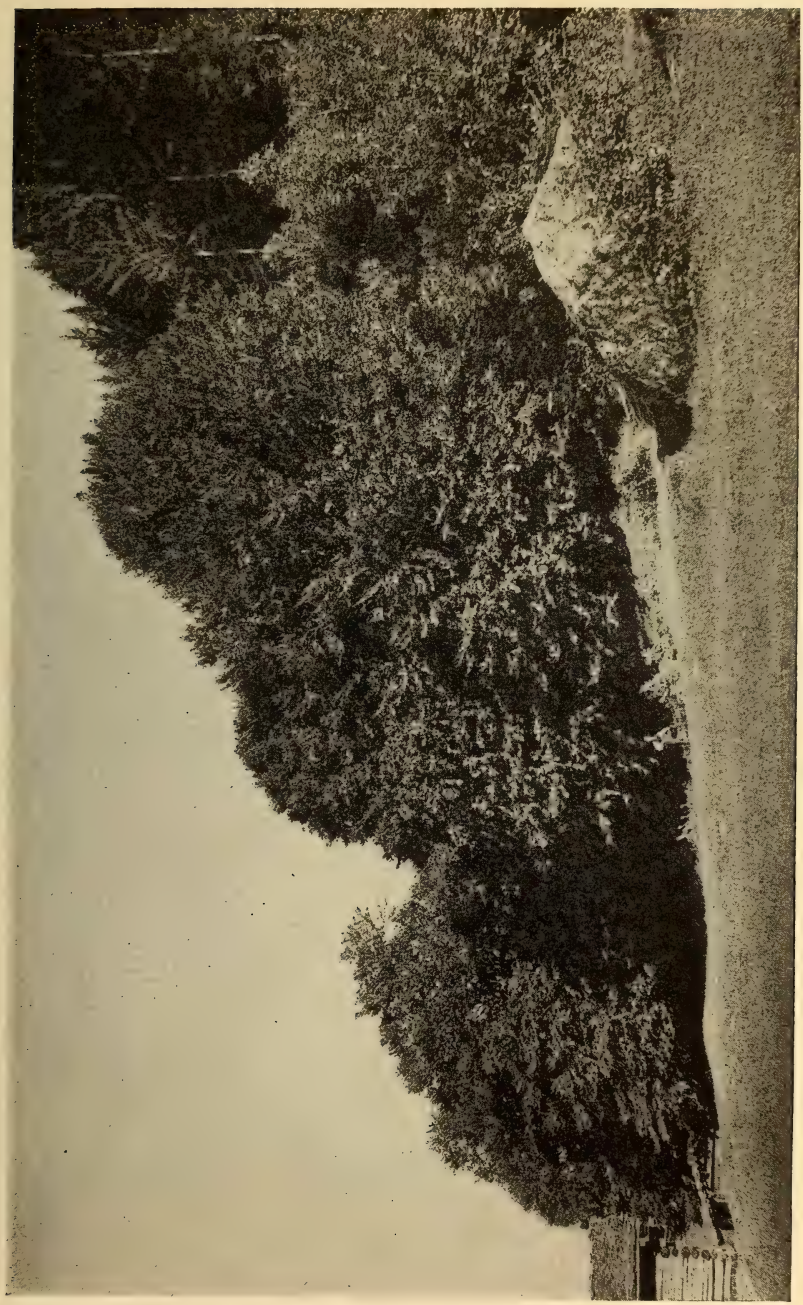

Fig. 13. Beeches (*Fagus sylvatica* L.) near Flims, Grisons. Photo Hager.

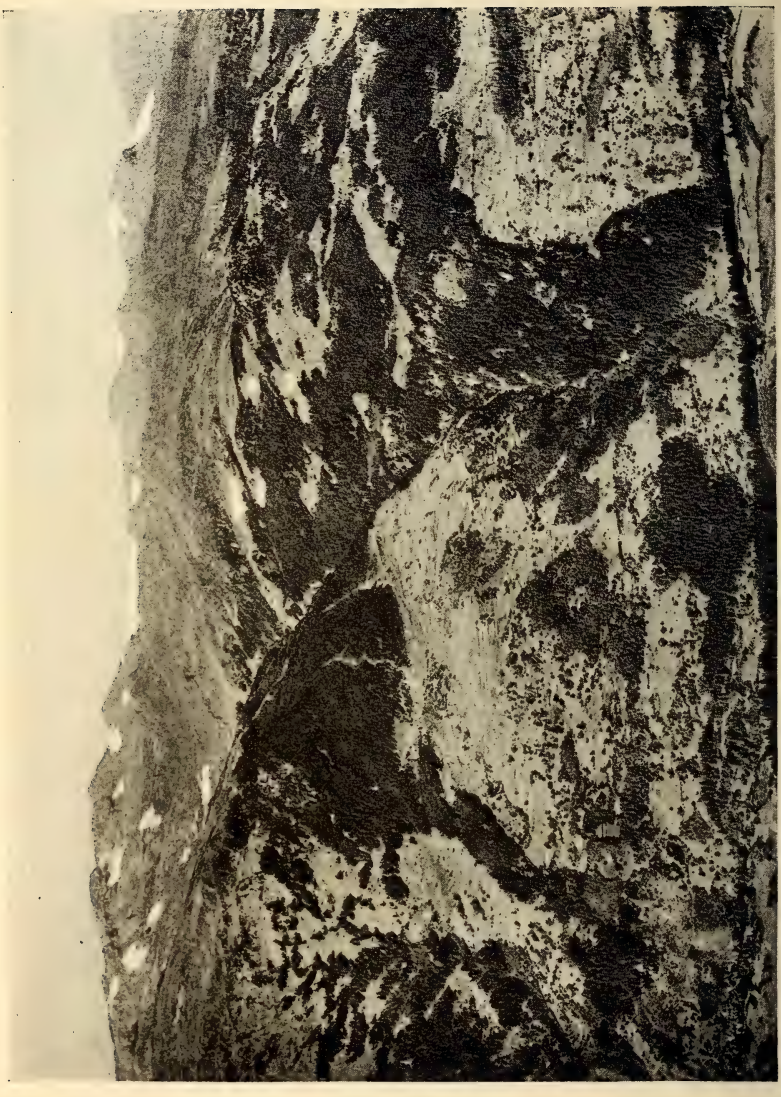

Fig. 14. View from Piz Mundaun, looking north near Ilanz, Grisons. The coniferous belt, consisting of a forest of common spruce (*Picea excelsa* Link), originally covering the whole slope with a continuous forest, is now by human action interrupted by meadows and fields.

Fig. 15. The Scotch Fir (*Pinus sylvestris* L.), near the Campodials, Grisons.
Photo Hager.

Fig. 16. The Arolla Pine (*Pinus cembra* L.) at the timber-line in the Valley of Scarl, in the under Engadine (Swiss National Park). The Arolla Pine never shows low, reduced forms, but reaches its limit in unbroken vigor. Photo Meyer.

Mill. var. *prostrata* Tubeuf) are the dominant elements. We force through these thickets, and now we stand on the free alpine pasture covered with thousands and thousands of bright-colored flowers. "Nothing in the world equals this splendid spectacle," says Dr. Christ; "we hesitate to advance fearing to crush under our feet these delicate beings." In ascending we see by degrees the continuous sward dissolving into isolated green patches. They begin to mingle with white patches of perennial snow, the outposts of the snow-belt, and finally we enter the dominion of eternal snow, the recent glacial period.[5]

II.

Previous to the study of the typical plants of the alpine belt, we will take a brief view of its climate. Its principal features are the following ones:

The shade temperature falls lower and lower as we ascend, but this loss of warmth is more than compensated by the enormous increase of the effects of sunshine. We see this difference in the clearest manner in comparing a thermometer in the shade with a thermometer in the sun. Frankland has made such experiments with the following results: He found at Witby in England (66 feet above the sea), 91° Fahrenheit in the shade, 100° Fahrenheit in the sun, a difference of 9°. At Pontresina, 6,000 feet above sea-level, the sun-thermometer showed already 31.5° Fahrenheit more than the shade-thermometer, and finally at the Diavolezu, at 10,000 feet above the sea, the thermometer showed 43° in the shade, 139.1° in the sun, thus a difference of 96° Fahrenheit. Dr. Rübel found at the Bernina hospice, 8,000 feet above the sea, a still greater difference of 111.6° Fahrenheit, 12.2° in the shade, 122.9° in the sun. Saussure found on Mont Blanc even a difference of 162° Fahrenheit!

This plenty of light and warmth that the alpine sun spreads to the alpine plants is the key to understand their flourishing growth. But there is one great drawback, the shortness of the period of vegetation. The period shortens nine days for every 333 feet of ascending. In the alpine belt it has a decreasing duration of from five months to only three weeks; in this short lapse of time high alpine plants must perform all their biological duties.

On the other hand, this shortness of the vegetation time is a little compensated by another important difference between lowland cli-

[5]Lately, I. Braun, Die Vegetation der Schneestufe in den Rhätische-lepontische Alpen, Ein Bild des Pflanzenlebens an seinen ausseresen Grenzen ("Neue Denkschriften der Schweiz. Naturf. Ges. Band XLVIII. Basel, 1913"), has in an excellent paper proposed the following division of the snow-belt of the Swiss Alps:

Pionirrascu (isolated patches of mats),—up to 150 m. above the snow-line.

Area of Dicotyledons (mostly cushion plants),—up to 550 m. above the snow-line.

Belt of Thallophytes,—from the last Phanerogams to the highest peaks.

mate and alpine climate, namely, the temperature of the air at the time of the melting of snow. This temperature increases with the altitude. Hence it comes that the alpine flora finds a warm air immediately after the melting of snow. So we understand the fact that close to the edges of snow-fields we find the bright colors of alpine spring flowers.

Very important for the growth of alpine plants is the fact that the alpine vegetation begins late in the year, in June or July, when the days are long and the nights are short. Now, you know that it is especially in warm nights that plants grow and shoot their stems, whereas the light of the day favors the production of organic material by means of the energy of the sun-rays. Thus our alpine plants are able to assimilate copiously during the long warm days with their strong insulation; but in the short and often very cool nights they cannot prolongate their stems; hence the dwarf habit of alpine plants; it is a direct effect of climatic favors.

But we must be aware of the fact that there exists another dwarfness, a hereditary one, not directly produced by alpine factors, but favored by natural selection. The dwarf Pine (Krumholz, *Pinus montana* Mill. var. *prostrata* Tubeuf), for instance, remains dwarf even in the lowlands! It is clear that a dwarf habit is very useful to alpine plants in many respects: against the mechanical effects of the thick layer of snow; as a means of protecting the plant against frost and the winter dryness, being covered by snow; and as a means to take advantage of the warmth of the soil.

The mountains are well known as rain and snow catchers; the layer of snow is thick and lasts a long time. How enormous quantities of snow may accumulate at places is shown in a picture taken by Dr. Rübel at the Berninapass, where the stage is driving between snow walls 9 to 12 feet high.

III.

But enough of this preparation: let us now enter the living alpine world and become acquainted with its principal types. We begin with the alpine thicket and its most popular shrub, the Alpenrose, the queen of the alpine flora, which garbs in radiant purple entire slopes. We have two kinds of Rhododendron in our Alps; the two are evergreen shrubs with leathery leaves. The brown one (*Rhododendron ferruginum* L.) has leaves which are brown underneath through glandular scales; the hairy one (*Rh. hirsutum* L.) has very few brown scales, and the edges of its leaves are fringed with long hairs. If the two grow side by side, regularly there arises a natural hybrid: if a busy bee transposes some pollen from stamina of a hairy specimen to stigma of a brown one, there ripens a seed out of which grows an intermediate being which shows a mixture of the characters of both parents. Our alpine roses are old Tertiary pure

alpine types restricted to the Alpine range and the Carpathian Mountains; they are near relations of the great Rhododendrons of the Himalaya. They ascend to 7,000 feet; it is very probable that their upper limit is an indication of the former upper limit of trees.

Also the green Alder (*Alnus viridis* (Chaix) Lam.) covers the slopes immediately under and above the actual tree-line with its bright green, helping to fasten slipping ground.

Fig. 17. The Dwarf Pine (*Pinus montana* Mill. var. *prostrata* Tubeuf) covering a grassy slope near Davos; about 2,000 meters above the sea. Photo Wünsche.

The dwarf Pine (*Pinus montana* Mill. var. *prostrata* Tubeuf) (Fig. 17) ranks especially as a pioneer on calcareous slopes; the black masses assaulting the fortresses of moving rubbles in the dolomites of the lower Engadine consist of dwarf pines. With its long flexible twigs, this bush is marvelously adapted to retard avalanches and to protect the soil. These larger shrubs of the shrub-belt are substituted in higher altitudes by stunted little dwarfs, which spread over the ground with horizontal twigs, all in one level like a mat.

A near relation of the Rhododendrons is the trailing Azalea (*Loiseleuria procumbens* (L.) Desv.), which forms a thick carpet on the ground and opens its beautiful little rose-flowers in the beginning of the alpine spring. It has a wide distribution; it is a dominant type in the circumpolar tundra, lives in the Altai, the Pyrenees, the Alps, Carpathian and Balkan mountains. But notwithstanding this wide spreading it has no varieties and is the only spe-

Fig. 18. *Salix herbacea* L. Schematic drawing—vertical section of the ground, representing mode of growth. Male plant at left, with catkins in flower. Female plant at right, with catkins in flower and in fruit. Photo Schröter.

cies of its genus; a classical example of a primeval but nevertheless still vigorous type with great power of expansion.

All these alpine shrubs show a very slow growth of the stem; the annual layers are often very narrow; 0.07 mm. in the case of the Azalea, so that a stem 55 years old has a diameter of only 7 to 8 mm. The comparison of the alpine rate of growth with the tropical growth is striking: in comparing a cross-section of a tropical Acacia 6 years old with the stem of our Azalea 55 years old, the growth in the Alps is seen to be 615 times slower than in the tropics.

The last link in the chain of more and more reduced dwarf shrubs is the dwarf Willow (*Salix herbacea* L.), called by Linnaeus "the smallest of all trees." It thrives in our Alps in a belt from 6,000 up to 11,000 feet above sea-level; it can reach the age of 40 years, but the whole stem and the branches are completely hidden in the ground (Fig. 18); only the tops of the twigs come above the soil, bearing two little leaves and a delicate catkin, male or female. This mat-forming tree is the strongest expression of the adaptation of a tree to high alpine conditions.

Fig. 19. "The Smallest Tree of the World"—Dwarf Willow (*Salix herbacea* L.). A pure association seen from above. The ground is completely covered with the short twigs of the plant, bearing two rounded leaves and a little catkin. The rest of the tree is hidden in the ground. "Snow Valley" at Pasture Di Lagalb, near Bernina hospice, at 2,400 meters above the sea.

Photo von Ostrom.

It likes the so-called "snow-flushes," little depressions always saturate with snow-water, where it often forms pure carpets of several square feet (Fig. 19). It belongs historically to the "Glacial Migrants," plants which have reached their present distribution under glacial conditions. It is widely distributed also in Arctic regions.

Leaving these representations of woody plants, we turn now to the herbaceous species. There we find first a group of large plants forming on humus and manured soil of herbaceous thicket ("Hochstaudenflur," or tall herb growth). They form often a typical association of chalet-plants or leger-plants, forming a luxuriant garden round the alpine huts. Only azote-loving plants not touched by cattle can live in this over-manured soil, and so we find on this fertile soil a vegetation of absolute weeds, a great drawback in the economical feature of our Alps. Experiments on the Fürstenalp near Chur in the Grisons have shown that it is possible to convert these thickets of weeds into splendid artificial meadows, and so hundreds and hundreds of acres of the best alpine soil can be added to the cultivated alpine land.

Now we tread on the continuous vegetation of the alpine pastures and meadows. The floristic composition, the plant association of this sward, depends essentially on its treatment by the alpine farmer. The master factor is here the manuring, which favors certain plants and discourages others; in a secondary manner work as a selecting factor the scythe and the pasturing of cattle. The flora of the meadow belt of our Alps is only to be understood as an effect of those artificial factors which since centuries ago operated with the same force as climate and soil.

The richest flora is to be found on those steep grassy slopes where the cattle do not have to go and where only occasionally the herder exercises his dangerous work of cutting his "Wildheu." These slopes of wild hay are the El Dorado for the botanist.

Next to these come in floristical variety the non-manured but regularly cut meadow, where often upward to 8,000 feet a luxuriant vegetation enraptures the botanist. Far more uniform in their vegetation are the manured meadows of the valleys, and the most trivial flora show in open pastures, where the tramping, pasturing, and manuring cattle exercise a triple trivializing influence. Also the soil of meadow and pasture is different: the first is smooth, the latter covered by hundreds of little depressions caused by the feet of the cattle.

We wander through the pastures in springtime; the snow begins to melt and at the edges of the snow-fields the life begins to rise. With flower-buds ready to open, the Soldanelles wait for the first breath of spring, when they pierce the thin covering of snow, aided by the sun, which, permeating the snow, warms the little brown flower-stalks. And next they open triumphantly their delicate flower-

bells above the white grave, one of the most touching spectacles of the victory of life over death. In their thick leathery leaves those typical alpine spring plants have stored up a rich reserve of food in the form of thickened cellwalls, containing a soluble modification of the cellulose. All the four species of the Alps (*Soldanella montana* Mikan; *S. alpina* L.; *S. pusilla* Baumgartner; *S. minima* Hoppe) are endemic, are autochthones of our mountains. The honey secreted in the base of the flower is protected from rain and from unbidden guests by the hanging position of the flower and by little scales projecting from the corolla.

Another plant of the melting snow is the spring Anemone (*Anemone vernalis* L.), which charms us by the long silky golden hairs covering the flower and its stalks, forming a good protection against

Fig. 20.—Spring Anemone (*Anemone vernalis* L.) on Mt. Pilatus near Luzern. Photo Arnberg.

dangerous loss of water, checking transpiration (Fig. 20). We must not forget that the cold soil saturated with snow-water is "physiologically dry," because the roots cannot fully perform their duty to pump the water. So we understand the curious fact, that a plant growing in wet soil has adaptations against drought.

The spring Saffron (*Crocus albiflorus* Kit.) follows with the snow of its flowers directly after the snow of the winter; also this plant shows means to check transpiration (Fig. 21).

Fig. 21. Spring Saffron (*Crocus albiflorus* Kit.); blooming in profusion produces the effect of a flower-snow after the melting of the winter snow. Rigi-Kaltbad, 1,300 meters above the sea. Photo Gnaz.

In the alpine summer the deep blue flowers of the common bell Gentian direct themselves toward the sun. There are two representative species, the one (*Gentiana Kochiana* Perr. & Song.) on siliceous, the other (*Gentiana Clusii* Perr. & Song.) on calcareous soil (Fig. 22). The flowers belong to the revolver type: they have five different honey-holes in the ground of the corolla, each of which is to be sucked apart by the pollinating insect. And these honey cavities are illuminated from outside by the light which penetrates through windows; the botanists call this a window-flower!

The delicate short-leaved Gentian (*Gentiana brachyphulla* Vill.) has flowers which can only be pollinated by butterflies, the long and very narrow tube of the corolla excluding other insects. This category of flowers, the butterfly-flower, is very frequent in the alpine belt, owing to the relative frequency of the butterflies in the Alps. If you have once the chance to view the meadows of Upper Engadine in June, as the period of the richest flora, you will be astonished at the innumerable mass of butterflies visiting the flowers.

On the much used pastures grow often our three best forage herbs: the alpine Plantain (*Plantago alpina* L.), the Spingel (*Li-*

Fig. 22. Common Bell Gentian (*Gentiana Kochiana* Perr. & Song.), Fluela-Schwarzhorn, Grisons, 2,600 meters above the sea. Photo Guyer.

gusticum mutellina (L.) Crantz), and the alpine meadow-grass (*Poa alpina* L.). The Spingel is an autochthon element, from its aromatic qualities much sought by cattle. It has a well-developed, much branched rhizome with long subterranean creepers, so that one plant may cover some square feet. These creepers are covered with sleeping buds, forming quite a lot of reserves for replacing lost aerial shoots eaten by the cattle. This faculty of reproduction is very useful to pasture plants.

The third plant is a grass, the alpine meadow-grass; it is often what is falsely called "viviparous." Instead of producing flowers and fruits, the spikelets grow directly out in a little plant, in bulbils, which, after dropping off the mother plant, take root directly, and so form a very sure and abundant means of vegetative propagation. It is a very important fact that the cattle do not touch the panicles full of young bulbils, though these would seem to be an excellent food; but in order to be able to bear the weight of all the bulbils, the stalk is so fibrous that the cattle do not like it. We see here a very instructive example of the fact that a certain structure caused directly by a mechanical stimulus becomes useful indirectly in quite another direction. Our meadow-grass is a very widely distributed circumpolar element, that lives also on the Ural, the Himalaya, and the Rocky mountains.

On sunny dry calcareous slopes we meet the most popular of alpine meadow plants, the "Edelweiss" (*Leontopodium alpinum* Cass.). The attractions of this plant, caused by its pure white color, the "noble white," and by its extremely local distribution often on steep slopes, cause more accidents than the difficult ascensions of icy

Fig. 23. Edelweiss (*Leontopodium alpinum* Cass,), Valley of Zervreila, Grisons.

peaks (Fig. 23). It is not an autochthon alpine plant, but properly an inhabitant of Asiatic steppes. It is a typical "xerophyte," protected against drought by its thick woolly covering of air-filled and therefore snow-white hairs. The so-called flower at the end of the stalk has a very intricate composition; it consists of several distinct flower heads, each with hundreds of individual flowers. These are four kinds: hermaphrodite, male, female, and honey flowers. These four different flower forms are distributed in various manners among the flower heads. The pseudoflower is rendered still more conspicuous by a beautiful white star consisting of broadened ordinary leaves, which surround the cluster of heads as an apparatus for advertisement for the insects. The white color serves here therefore for the purpose of the pollination; but its primary nature is in connection with the rôle of the hair-covering as a means of protecting the plant, with the result that a certain useful structure has become useful afterward in quite another direction.

Fig. 24. Round-leaf Penny Cress (*Thlaspi rotundifolium* (L.) Gaud.), a typical scree-creeper, emerging between the stones. Photo Teager.

At the marshy margin of alpine lakes and ponds thrives, especially on siliceous ground, a grasslike plant of arctic origin, the cotton-grass of Scheuchzer (*Eriphorum Scheuchzeri* Hoppe). You see it here fringing with snowy fruiting heads the shallow water of little depressions between the *roches moutonnées* near Bernina hospice. The white color is also here the effect of the air-filled hairs; they accompany the fruit and serve as a flying apparatus, helping the distribution by the wind. They have nothing to do with transpiration nor advertisement, the air is here exclusively as a means for diminishing the weight.

We have now made the acquaintance of some of the principal types of meadows and pastures. We leave them to study the flora of rubbles and rocks.

The moving slopes of rubbles, the screes, have quite peculiar conditions of life for their inhabitants. The stones menace continually their shoots and the soil is distributed in little heaps on separate stones; therefore we find special adaptation in the scree-plant.

The round-leaved Penny Cress (*Thlaspi rotundifolium* (L.) Gaudin) (Fig. 24) is one of the most constant inhabitants of moving débris; never do we find it on the pasture. The special method of avoiding the dangers of its habitat consists in spreading with long flexible creepers through the gaps between the loose stones, here and there sending out rootlets where it finds a little sediment of detritus. With isolated aerial shoots it emerges from the rubbles to unfold its roundish leaves and its violet flowers. The plant is an endemic product of our Alps. In similar manner the bluebell of Mt. Cenis (*Campanula cenisia* L.) penetrates with long shoots the narrow gaps in the rubble slopes.

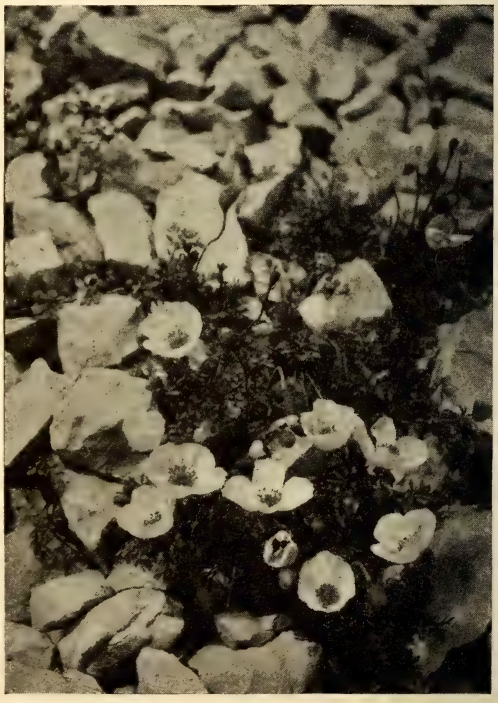

Fig. 25. White Alpine Poppy (*Papaver alpinum* L. var. *Sendtneri* Kerner), in limestone screes at the Pilatus near Luzern, 1,900 meters above the sea. Photo Guyer.

The beautiful alpine Poppy (*Papaver alpinum* L. var. *Sendtneri* Kerner) follows another system of resisting the menacing soil movements of its habitat, opposing itself with big clusters of crowded roots against the moving stones (Fig. 25). It is a rare inhabitant exclusively of calcareous débris. It is a delicious spectacle to see hundreds and hundreds of little islands between the bare stones garnished with their delicate white flowers.

One of the saxifrages, the genus so rich in alpine species, the purple Saxifrage (*Saxifraga oppositifolia* L.), is widely Arctic-Altai element of the alpine flora, using the two modes of growth, creepers and compact clusters. It has wandered once in the glacial time with the increasing glaciers to the foreland of the Alps; and after the glacial epoch, as the glaciers retreated to their present state, it has subsisted in isolated colonies upon the gravel along the shore of the Lake of Constance, as a typical glacial relic.

Another kind of alpine débris, a resting flat stony soil, saturated with snow, is inhabited by some high alpine plants, the Gentian (*Gentiana bavarica* L.) (Fig. 26) and the glacial Buttercup (*Ranunculus glacialis* L.). The buttercup is a circumpolar arctic element; it forms often true gardens of white and rose flowers in absolutely glacial conditions, up to 14,250 feet, the absolute upper limit of flowering plants in Switzerland (Fig. 26). It is a noticeable fact that this most resistant plant shows no visible adaptation to the extreme conditions of its glacial stations; it has a smooth somewhat fleshy stem, glabrous leaves, forms no cushions: we have here one of those instructive cases where the power of resistance lies in the constitution of the living substance, is purely physiological, and shows no morphological expression. Similar stations upon wet sand in the high alpine belt are adorned with the rose cushions of Androsace alpina (L.) Lam.

The last ecological group of the alpine plants are the rock-plants, the inhabitants of bare rocks. We can here distinguish, after the mode of fixing itself upon the rock, two sub-groups: Lower (cryptogamic) plants, lichens and algae, are clinging directly to the bare rocks, perforating its surface with their stone-dissolving cells, aiding erosion, preparing the soil for higher plants. The other group, including mosses, ferns, and flowering plants, is confined to the sediments of detritus in fissures or upon little bands of rock (chomophytes).

One of the most exclusive of our alpine rock-plants is the rock-Potentilla (*Potentilla caulescens* L.), which thrives only in the fissures of vertical rock-walls, penetrating deeply the rock and forming in the fissures often quite a texture of entangled rootlets. It has no adaptation at all against drought; it is a typical mesophyte, and therefore a proof of the fact that rock stations are not necessarily dry ones; the rock on the contrary is often quite a reservoir of water. Also the yellow Primula (*Primula auricula* L.) is confined to calcareous rocks.

Fig. 26. A typical association of high Alpine plants on humid screes of granite at the Vereinapass, Grisons, 2,600 meters above the sea. *Cerastium uniflorum* Murith. *Ranunculus glacialis* L. *Gentiana bavarica* L. var. *imbricata* Schleich. *Chrysanthemum alpinum* L.

A very typical group of rock-plants are the cushion-plants, forming thick hemispherical cushions, covered with short-stalked and closely adhering flowers. Their twigs radiate from a center; they are thickly covered with little closely-set leaves, which remain withering on the stem, filling the whole interior of the cushion with decaying material, forming a sort of spongy mine of humus. The living leaves form a continuous covering over the compact interior, and are hairy or leathery. The whole structure of these cushions is to be understood as a manifold protection against drought and intense wind: transpiration is checked by the hairy or leathery structure of the leaf, by the low growth near the soil, where the wind is less intense, and by the compact structure of the interior. The spongy mass of humus forming the interior with its thousand and thousand capillary cavities works as a sponge retaining the water; it holds the soil underneath in a damp state and prevents high temperature.

We find the cushion form in many plants of seemingly very different stations. On the stormy treeless shores of the sub-antarctic islands, especially Kerguelen, grow cushions of some meters in diameter (*Bolax gumifera* (Lam.) Spreng.); on the wet but cold peat-moors of the Andes, as well as in the dry hot sands of the Sahara, we find cushions; on crests and summits; so especially the Swiss Androsace (*Androsace helvetica* L.) exclusively found in the calcareous Alps, an autochthon product of them and much more characteristic of our Alps than the Edelweiss.

On the whole earth we find 338 species of cushion-plants in 34 different families. That is a classical example of convergence of the fact that plants from the most different families adopt very similar habits through the influence of similar conditions. Indeed, if we compare the different stations cited above, they are all, for plant life, to be characterized as dry, as menacing the plant with drought. Their soil can well contain much water, be physically wet; but this water is only with difficulty available for the plant (retained by humus or because the soil is cold). The soils are physiologically dry (peat moors, cold alpine soils), or the stations are exposed to constant loss of water by intense wind; so on the wind deserts of the sub-antarctic islands and on the exposed summits of the Alps. Here in the Alps especially the winter with its dry air and frozen soil becomes a danger so much the more as many of our alpine cushions, especially the Swiss Androsace, prefer the most exposed positions where the snow is constantly blown away.

I come to the end; I wish finally to recall to you that we have convinced ourselves that the total features and entire household of alpine plants is a most faithful expression of alpine conditions of life. The principal characteristics of the alpine flora, the dwarfy growth, are of a double nature; on one hand they are direct effects of climate by means of plentiful light and the cold nights, on the

other hand the dwarfy growth is indirectly favored as a protection against snow and wind, and as a means of better utilization of the warmth of the soil and the greater dampness of the atmosphere near the soil. The anatomical structure of the leaf shows many relations to a greater assimilatory power in connection with the intense light. The leaf is thicker, has well-developed palisade cells, many breathing pores, abundance of chlorophyll, many intercellular spaces; in short, it is a typical sun-leaf. The temporarily great power of evaporation of the air and the intense wind cause manifold zerophytic adaptations; an extreme one is the cushion habit.

The short period of vegetation stands in relation to the rareness of annual plants, because they have difficulty to ripen from seed to seed in the short summer. It causes also the great percentage of evergreens, which in spring are at once ready to assimilate. It favors early flowering; it causes the small annual layers of woody plants. We understand the brightness, the dominance of the flowers in comparison with the green body of the plant in considering the factors which reduce the vegetative organs have no reducing effect on the flowers. Also the intense light and the selecting influence of the pollinating insects play here a certain rôle.

So we gain by the study of the alpine flora an insight in the narrow connections between the living nature and the surrounding factors. He who has an open eye for these fascinating studies will have a double enjoyment in rambling through the lofty scenery of the mountains.

THE NATIVE WALNUTS OF CALIFORNIA

Willis Linn Jepson

A good many years ago, while looking over the interesting maps which accompany Sargent's Report upon the Forest Trees of the United States for the Tenth Census, I was much struck by the band of color extending from the Pacific Ocean to the borders of the San

Fig. 27. The leaf marked *a* belongs to *Juglans Californica*, or the Southern California Walnut, which grows on dry hillsides. The leaflets are rather obtuse and often crowded, as shown in the figure. The leaf marked *b*, with the leaflets more pointed and less crowded, is typical of *Juglans Hindsii*, the Central California Walnut, which commonly grows along streams, and always in deep rich moist valley or bench soil. *Juglans Californica* is distributed from Santa Barbara County to Orange County and east to the foothills of the San Bernardino Mountains. *Juglans Hindsii* is known to occur on Walnut Creek, the lower Sacramento River, near Mt. Atlas in Napa County, and in Gordon Valley west of the Vaca Mountains. Drawing by Dr. Helen M. Gilkey. About ⅔ natural size.

Joaquin Valley and from San Francisco Bay and its arms south to Orange County, which indicated the distribution of our native walnut (*Juglans Californica*). At that time I knew only two stations in the north for native walnuts, one at Walnut Creek near Mt. Diablo, the other in the lower Sacramento River delta about Walnut Grove, this latter beyond the limits of the colored area on the map referred to above. No locality between Mt. Diablo and the northern boundaries of Santa Barbara County was known to me, nor has subsequent exploration or inquiry revealed any station to bridge the long gap between the northern and the southern localities for our native walnuts.

In 1901 Mrs. Ida M. Blochman sent from Santa Maria a collection of fruits of the native walnut. I was much struck by the very small size of the nuts (they were only about 5/8 inch in diameter) as compared with the nuts borne by the trees about Walnut Creek, which are over an inch in diameter. These and other differences led the writer to publish the northern tree as a variety (var. *Hindsii*) of the southern California species. As is frequently the case after publication, information flowed in more rapidly, and seemed to indicate that the northern tree should be regarded as a distinct species. This continued accession of knowledge sometimes discounted this view, sometimes fortified it. Meanwhile Professor Ralph E. Smith, of the Division of Plant Pathology, University of California, had been cultivating both the northern and southern forms in connection with his horticultural work on walnuts, and found striking differences in behavior of the seedlings and young trees. The two were planted in rows side by side: the southern form branches low, giving the young tree a pyramidal effect; the northern form is erect, spindling, not having strong branches or scarcely any. These differences forecast the marked differences in habit between the two forms: the southern form is, strictly speaking, a shrub, gigantic, or even elephantine, but still a shrub in its architecture, with many spreading stems from the base; the northern form is of forest-tree type, even in the open, with erect trunk ten to forty feet high, and bearing a symmetrical and not necessarily very broad crown. These differences thus seem inherent and not ecological. Professor Smith also found in his cultural plots at Whittier that the southern seedlings were healthy and vigorous, while the northern ones took the "yellows" badly; the southern form produced and held its leaves for a period of 3 to 4 months longer during the year than the northern form.

These and other considerations (see Figs. 27 and 28) seemed to require the specific separation of the northern form, and the writer gave to Professor Smith the name *Juglans Hindsii* Jepson, which he published in connection with his walnut work in 1909. Such evidence as has more recently appeared supports the view then taken. The citation of the two species are therefore as follows:

1. JUGLANS CALIFORNICA Wats. Proc. Am. Acad. 10:349 (1875), as to the Southern California plants. Dr. Watson had only Southern California material before him and the southern walnut is in consequence taken as the type of his species.
2. JUGLANS HINDSII Jepson, in Smith, Univ. Cal. Agr. Exp. Sta. Bull. 203:27 (1909). *J. californica* Wats. var. *Hindsii* Jepson in Bull. S. Cal. Acad. Sci. 7:23 (1908). This species was so named in memory of Richard Brinsley Hinds, botanist of the British exploring ship "Sulphur," who first discovered it on the banks of the Sacramento River in 1837.

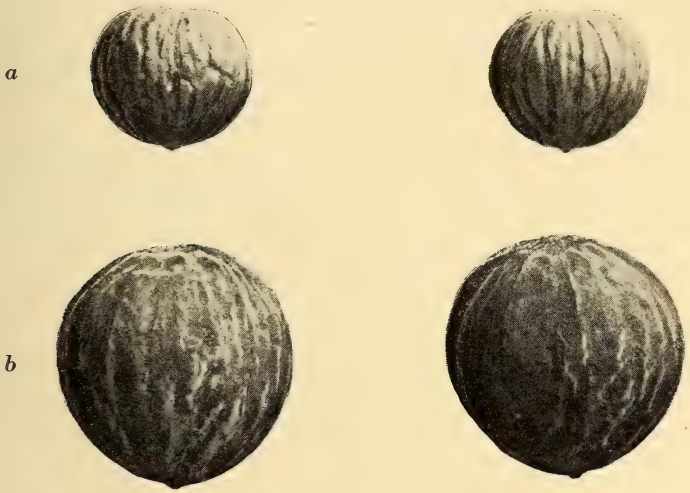

Fig. 28. This illustration shows the relative size of the nuts of the two California species of walnuts. Note at *a* the small walnuts of the Southern California Walnut, *Juglans Californica,* with their longitudinal channels. The nuts marked *b* show the smoother-surfaced nuts of *Juglans Hindsii* of Central California. In both the husks have been removed. For the photograph the writer is indebted to the courtesy of Professor E. B. Babcock. Nearly natural size.

CALENDAR OF MEETINGS

March 20, 1915.—A business meeting for nomination of officers was held at the home of Dr. W. F. Badè. After the business was transacted, Dr. Badè gave an informal talk on his observations of bird and plant life in the Sierras, illustrating by stereopticon views.

April 10, 1915.—Annual meeting at Oakland Public Museum. Election of officers. Lecture by Prof. William T. Horne—Subject, "Prevention of Cruelty to Trees." Prof. Horne told how the dissemination and practical application of knowledge regarding the trees of our streets, parks, and orchards might prevent a large part of the disease to which they are subject, and of the retarded growth, malformation, and death which results from disease.

May 15, 1915.—Regular meeting at Oakland Public Museum. Round-table discussion of methods of procedure in collecting and preparing herbarium material, illustrated by specimens from the current exhibit by the Society. Discussion of plans for development of the Botanical Society Herbarium.

REPORT OF FIELD TRIPS

April 11, 1914.—The party went by train to Felton, in the Santa Cruz Mountains, Dr. T. H. Goodspeed being the leader, with the special object of studying *Trillium sessile.* The floor under deciduous trees covering a flat along the river was rich in the number and variety of the individuals of this species. Some seedlings of the first season, plants of two seasons, and those of three or more were studied for their distinguishing characteristics.

April 25, 1914.—The field party on this date was taken over the private grounds of the leader, Mr. Duncan McDuffie, on the Tunnel Road, Berkeley, where a study was made of certain native shrubs growing naturally or that had been transplanted along the arroyo running through the grounds and of liliaceous plants which were being tried under cultivation.

May 3, 1914.—The leader, Mr. C. W. Carruth, led the trip to Moraga Ridge, near Pinehurst. Along the summit of the ridge grows the Knobcone Pine (*Pinus tuberculata*), the only locality for it in the San Francisco Bay region. The rocky ridge furnishes this species a characteristic habitat.

May 9, 1914.—The trip to Telegraph Cañon, Berkeley, was under the guidance of Dr. Badè, who called special attention to char-

acteristic structural features of common plants that were adapted to their normal environment, and to the relation between the same common species and the insects that visited them.

May 16, 1914.—With Mr. Wallace C. Von Helms as leader, the field party walked through the San Leandro Hills to Lake Chabot. Associations of plants normal on rocky, rather open hillsides and in the creek beds, were observed. On the hills *Papaver heterophyllum* and some species of Linanthus were found. In the flats *Platanus racemosa* (Sycamore) and some species of *Salix* (Willow) received more attention.

May 30, 1914.—Inclement weather forced the members of the party which had braved its threats to confine their observations chiefly to the garden of Miss Alice King, in San Francisco, where they were told something of Miss King's efforts and success in growing native plants for seed.

June 13, 1914.—The trip to Bay Farm Island was under the leadership of Mr. John A. Imrie. This locality is remarkable for its interesting halophytes, and observations were made of *Salicornia ambigua, Suaeda Californica,* various Atriplex species, *Cuscuta salina* (Marsh Dodder), and other plants of the salt marsh association.

October 4, 1914.—The trip to Twin Peaks, San Francisco, was under the leadership of Miss Alice King.

October 17, 1914.—The walk to Bay Farm Island was made, with Mrs. D. W. de Veer as leader, for the study of the plants of the salt marsh, the rich flora of which is most highly developed at this time.

October 31, 1914.—The condition of the native shrubs at the end of the dry season was the special object of the field trip to Strawberry Cañon, University campus, Berkeley. Mrs. Harriet P. Kelley was the leader.

November 7, 1914.—Mr. L. Seymour Smith led the trip to Angel Island.

November 14, 1914.—Miss Harriet Walker led the party about the University campus, Berkeley, for observation of plants and shrubs flowering in November.

December 5, 1914.—The trip to Baker's Beach and Fort Point, led by Mrs. James B. Smith, was devoted to a study of beach plants.

Feb. 6, 1915.—The field trip to Shepherd Cañon was led by Mrs. Harriet Kelley.

March 6, 1915.—The field trip to Telegraph Cañon in the Berkeley Hills was led by Mrs. Adele Lewis Grant. *Trillium sessile* re-

ceived special attention, and demonstration was made of the proper method of selecting and preparing material for herbarium specimens.

March 13, 1915.—The Oso Berry (*Osmaronia cerasiformis* Greene) was the special object of field study on the trip to Redwood Peak, led by Miss Sarah Atsatt.

March 21, 1915.—Field study of fungi in Sutro Forest, led by Miss Alice King.

March 28, 1915.—Field study of grasses and clovers on the sand dunes near the ocean at San Francisco. Leader, Prof. P.B. Kennedy.

EXHIBITS

May 23, 1914.—Conference on field work and exhibit of material illustrating local associations. Round-table talks gave the experiences of various members. Mr. Robert P. Brandt related some interesting observations of *Trillium sessile* in different stands adjacent to the Bay region. Miss M. Alice King spoke of the great variety of native flowers still to be found within the limits of San Francisco, illustrating with many specimens. Miss Harriet Walker discussed thistles, both native and introduced species. Several other speakers added their notes regarding field observations.

October 9 and 10, 1914.—Demonstrations of ecological areas. Eight characteristic plant associations were represented, namely, Salt Marsh, Sand Dune, Beach, Redwood Forest Floor, Open Field of interior valleys, Desert, Chaparral, and Dry Open Hill. This exhibition was open to the general public, and the plants were arranged to illustrate as well as possible their habit and appearance in nature, and to convey the demonstration that plants are dependent upon and adapted to surrounding conditions.

LIST OF NEW MEMBERS

Atkinson, Miss Florence Edith
Bettys, Mrs. Julia A.
Branch, Miss Edna O.
Cassiday, Miss M. B.
Culp, Mrs. S. V.
Dahl, Miss Adele
Earl, Mrs. A. C.
Gericke, Prof. W. F.
Gilmore, Prof. John W.
Harford, Miss Crystal
Heath, Mr. Eugene Schofield
Hubbard, Miss M. Ellen
Hunt, Miss Isabel
Johnson, Miss Selma
King, Mr. Frank B.
Knickerbocker, Mrs. M. A.
Lillick, Mr. Ira S.
McCoy, Miss Florence L.
Moffitt, Mr. J. K.
Moffitt, Mrs. J. K.
Mott, Miss Susie W.
Mott, Miss Katherine
Mott, Miss Nellie
Olney, Mr. Warren, Jr.
Olney, Mrs. Warren, Jr.
Pope, Prof. Willis T.
de Reygades, Miss Ynes Mexia
Rice, Mrs. Bertha M.
Samuels, Mr. Frederick S.
Sellander, Miss May
Shreeve, Miss Minnie
Thompson, Mr. C. H.

GROUND BUR-NUT AT BAKERSFIELD

Jno. G. Brayton

There is one plant true to its name,—*Tribulus terrestris*,—for it is the terror of the earth. Ground Bur-nut it is also called. The history of the plant locally seems to be that the first specimens were brought here from Arizona in sheep or cattle cars about 1905. It grew along the Santa Fe railroad track first, but being adapted by nature to traveling it soon spread far over the county, following ways of travel for the most part.

The foliage is rich green and appears more so since it grows in the dry summer. The fruit is a pointed nutlet, having five pairs of thorns, which are just long enough to pierce a bicycle or auto tire. In fact I met it first on my bicycle and shall not forget it soon. In one case an auto tire had five punctures from a single brush with this simple-minded industrious plant. Since it grows right in the dust of the road where there does not seem to be a particle of moisture, you can readily understand how it is so hardy and spreads so rapidly. Perhaps you have already met with my little friend, or you surely will soon on the State highway; or if not, I will send a specimen when a good one appears.

[This plant belongs to the Caltrops Family (Zygophyllaceae) and is often called Puncture Weed. It is evidently traveling steadily, since it has been reported in the last four years from a number of widely separated stations in the State. It is a native of Europe, thoroughly aggressive, and is evidently destined to become a troublesome weed.

According to its original meaning, *tribulus* is a sort of instrument resting on three of its iron prongs, a fourth projecting upward. These devices were thrown on the ground and designed to impede the enemy's cavalry. The word has naturally been transferred to thorny or spiny fruits through the idea of resemblance.—W. L. J.]

Taxonomic Notes on Californian Plants.—The yellow Star Tulip of the Yellow Pine belt of the Sierra foothills has long been known as *Calochortus Benthamii* Baker (1874). It was, however, first published, with a figure, by Lindley in 1849 (Jour. Lond. Hort. Soc. 4:81) under the name *Cyclobothra monophylla*. This specific name is not distinctive nowadays, but under the rules of nomenclature the name must nevertheless be *Calochortus monophyllus* Jepson, n. comb.

The plant so long known as *Brodiaea grandiflora* Smith (1811) is in similar case, having been first published as *Hookera coronaria* Salisbury (1806). The correct name, then, is *Brodiaea coronaria* Jepson, n. comb.

Some plants of the genus Chorizanthe collected at Monterey have been brought to my attention. These have been called *Chorizanthe pungens* Benth. var. *nivea* Curran, a disposition which the writer accepted in the Flora of California (p. 392). It is now my judgment that this type of thing represents a distinct specific unit and should be designated as *Chorizanthe nivea* Jepson, n. comb.

The somewhat capituliform clusters are borne in dichotomous cymes on rather short branches in *C. nivea*, whereas in typical *C. pungens* the heads are racemosely scattered along elongated branches. The calyx of *C. nivea* is white with yellow tips; the calyx of *C. pungens* is white without yellow markings. The alternate involucral lobes of *C. nivea* have showy white borders; those of *C. pungens* are narrow, dull-colored and inconspicuous. *C. nivea* is erect or suberect in growth; *C. pungens* is trailing. Doubtless other points of difference may appear when these plants are better known.

The above names are published at this time on account of the returning of herbarium specimens of the species under the revised names.—W. L. Jepson.

Allotropa virgata T. & G., near Lake Tahoe.—Grows similar to *Sarcodes sanguinea*, pushing its way up through decomposed bark, needles and soil, late in July, and during the first two weeks in August, but differing from the Snow Plant in its root formation. The specimens which I am sending taper down until they join thread-like roots. In a radius of fifty feet, beneath a couple of firs (*Abies concolor* Lindl. & Gord.) I counted twenty-four stalks. The thread-like roots appeared to have formed a network underground and the flower stalks appear to spring from these.

I have found specimens only on northern exposures, beneath fir at an elevation of 6,700 feet, or thereabout. This year (1916) is the third summer this particular colony has made its appearance. The largest group has eight flower stalks ranging from four to fifteen inches in height. In their natural state the coloring of these plants is exquisite. They are for all the world like a bit of old-fashioned jewelry, garnets and pearls. The stalk striped garnet and white, the bracts white with occasional faint edge of garnet. The petals are white, the filaments white, the anthers garnet, the ovary garnet, the style white, the stigma garnet. The garnet anthers and stigma being surrounded by the white petals have the appearance of a setting for an old-fashioned ring of garnets and pearls. This species is more delicate and far more beautiful than the Snow Plant.—Adele Dahl.

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VOLUME I NUMBER 3

MADROÑO

Journal of

THE
CALIFORNIA BOTANICAL
SOCIETY

Contents

[Issued April 8, 1918]

MADROÑO

JOURNAL OF THE CALIFORNIA BOTANICAL SOCIETY

The purpose of the Journal is, primarily, to publish non-technical articles and notes on the natural history of the native and exotic plants of California; to furnish a medium of communication relating to measures in behalf of the preservation of the native flora, and to provide a record of the Society's meetings and activities. Notes upon the habits, life-history, or occurrence of native plants, or records of cultural experiments, will be especially welcome for publication.

The Journal is published at irregular intervals: Vol. 1, No. 1, 50 cents; No. 2, 50 cents; No. 3, 25 cents. For copies of the Journal and for information relating to the Society, address

MISS A. BRUCE WALKER, *Secretary-Treasurer*,
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Manuscript for publication should be sent to

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THE TWIST OF WOOD-FIBER IN THE TAMRAC PINE

CORNELIUS B. BRADLEY

During my college days in Ohio I once heard a back-woodsman holding forth on the "twist" of the grain of the "Northfield Oak" of Summit County. Its fibers, he affirmed, "always went round and round the trunk with the sun," and he was sure that the sun's daily movement across the sky caused the twist and determined its direction. I doubted the assertion that the twist in this species was invariably a left-hand twist, but I was perfectly sure that the sun's movement did *not* determine its direction. If it did, then all exogenous trees in our north temperate zone should have the same twist—which notoriously they do not. The questions thus started made a deep impression upon me, especially when I found out later that our masters in botany had no answers to them—and so far as I can learn they still have none.

A summer vacation in the eighties, spent in the neighborhood of a lumber-camp, showed me that my doubt as to the constancy of direction of the twist in any given species of tree was well founded. Both right-hand and left-hand twist occurred in every sort of timber cut there. In any given species, one direction was generally more common than the other, but it did not then occur to me to ascertain the ratios more definitely.

Three years ago, however, as I came down the Tioga road from the Meadows, there were stretches of forest where hundreds of tamrac pines *(Pinus contorta* var. *murrayana)* had been killed by the borers, and were standing by the roadside stripped of their bark as if awaiting physical examination. I at once recognized my opportunity and, pencil in hand, tallied the twist of some two hundred and fifty of them. Eighty per cent showed the right-hand twist. A few days later, in the remote and isolated Jack Main cañon, I made a similar tally which showed about seventy per cent of the left-hand twist. These observations seem to indicate that the direction of twist is a heritable quality, fairly well maintained along definite lines of descent, though somewhat interfered with by variation or by mingling with the opposite strain.

In the interval between these observations I had spent a day in camp at Porcupine Flat. There I looked up the leaf-arrangement of the tamrac pine, and worked out the direction of its fundamental leaf-spiral in a considerable number of trees about camp. I found here again the same variation between right and left-hand spirals that I had noted in observation of the twist of wood-fiber, and with a like preponderance of the one over the other.

This suggested, of course, a real connection of some sort between the two phenomena. If at the time I had recognized the full significance of the suggestion, I should at once have put the matter to the

test of crucial experiment. I should have ascertained the direction both of leaf-spiral and of fiber-twist in the *same* trees, stripping off the bark to make sure of the latter. If in a sufficient number of cases the two should be found to be either uniformly coincident or uniformly reversed, we should infer some causal relation, direct or indirect, between the two phenomena. On the other hand, if coincidence and opposition were found to be not uniform, we should infer either that these two phenomena are either wholly unrelated, or that some other cause or causes interfere to modify or obscure whatever relation might exist between them. My opportunity for making this experiment was thus lost; but I trust that some one else may find the problem sufficiently interesting to carry it through—and to report the results.

Meantime it may be well to examine a little into the nature of the leaf-arrangement of this pine, and consider what possibilities it affords for a causal relation between it and the twist of wood-fiber. The accompanying diagram (Fig. 28) is an enlarged representation

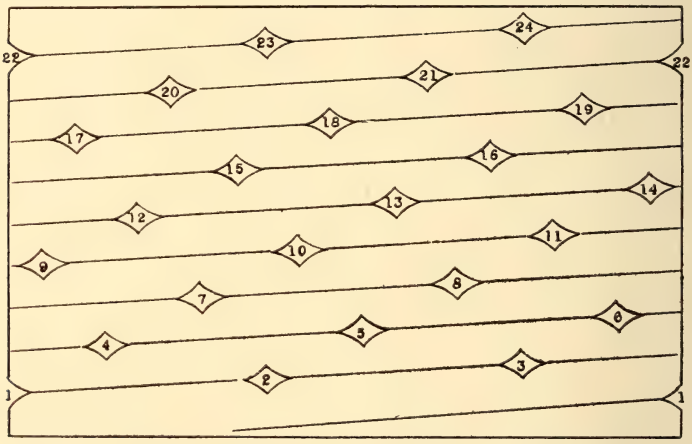

Fig. 28. Diagram of the Leaf-Arrangement of the Tamrac Pine

of the surface of a short section of the terminal shoot of a young tamrac pine in early spring, before it has attained its full length and has consolidated its wood-fiber. The outer layer has been cut open along a vertical line—which appears here at both the right-hand and the left-hand margins of the figure—has been stripped off and spread out flat. The numbered points are the positions of the leaf-clusters. The primary, or fundamental, leaf-spiral is the line which passes through all these points in order. It appears in the diagram as a series of transverse lines rising at a low angle toward the right. If the margins of the figure were rolled backward so as to meet again as they do on the stem, these lines would form the continuous spiral just described. Along this spiral the leaf-stations are

spaced equally at an interval such that only after making eight complete turns around the stem, and passing twenty-one stations, do we come to a station, No. 22, which stands directly above No. 1 and begins a second cycle exactly like the first. This particular arrangement is therefore called a right-hand $\frac{8}{21}$ arrangement. The corresponding left-hand arrangement would be exactly the same, save that right and left would everywhere change places, as they would were we to look at the reflection of this diagram in a mirror.

Now the general facts regarding the growth of wood-fiber are well understood, and may be summarized as follows:—The leaves develop one after another in ascending order according to their positions on the fundamental spiral. From the base of each, at a certain stage of development, bundles of wood-fibers begin to form, and these extend downward along the axis, interlacing with similar bundles from other leaves, till finally they form together a continuous shell of wood just within the layer of bark. Presumably the growth might be *directly* downward were there no obstacles in the way. But obstacles there are, as a glance at the diagram will show. Every leaf-base is such an obstacle standing more or less in the way of growth from above. For, if we choose as a starting point one of the upper leaf-bases in the diagram—say No. 23—we see that the space below it is free no farther than to No. 15. The left-hand margin of the bundle of wood-fibers from No. 23 is sure to encounter the right shoulder of No. 15, where doubtless some of its fibers will lose themselves in effecting the junction; and from this point on the bundle from No. 15, already established, forms a fixed barrier to any further spread of the bundle from No. 23 in that direction. But the fibers from No. 23 are still in process of formation, and are free to develop along the line of least resistance. The growth from No. 23 therefore we may think of as crowded over to the right until its edge touches the edge of the bundle from No. 18. Confined then between these two barriers, its general direction may be taken to be the line between No. 23 and No. 10—at which latter point its separate identity may be considered as coming to an end.

But what happens in the case of No. 23 is repeated in the case of every other station in the whole scheme. The exact repetition of the quincuncial pattern gives to every station in the diagram the very same position with regard to its neighbors, the same fixed obstacles, and the same open fairway. The whole sheet of wood-fiber, made up of the bundles from each leaf-base, must have the same inclination that they all have separately. Though the actual growth from each station is downward, yet since the development as a whole is upward, we shall avoid confusion by naming the direction of the slant here shown as if its lines really grew upward. We call it therefore a left-hand twist.

The hypothesis here is that a definite pattern of leaf-arrangement may cause a definite deflection in the line of growth of wood-

fibers by the series of physical obstacles which it places in their pathway. If the hypothesis be true, and be correctly applied to the conditions actually present in the tamrac pine, a right-hand leaf-spiral, as shown in the diagram, should give a left-hand fiber-twist; and conversely, a left-hand leaf-spiral should give a right-hand fiber-twist. This discussion therefore adds a second question for the prospective explorer in this field, namely: Are these hypothetical results borne out by the results of actual observation? An affirmative answer here, following an affirmative answer to the first question, would be an important step toward confirming the theory here suggested.

If the line of experiment here suggested does not at once consign this theory to the limbo where all its predecessors have gone, there is still left an enormous field of investigation to be covered before what may be established for this particular tree or for this particular leaf-pattern can be applied to exogenous tree-growth in general.[1] Science, as well Art, is long indeed—and Life alas is short for either!

FIELD NOTES ON ERICACEAE OF THE TAHOE REGION

Viola B. Baird

The field covered by these notes I have explored quite thoroughly during five consecutive summers. It includes both banks of the Truckee River from Lake Tahoe to Bear Creek, the valleys of Bear Creek and Squaw Creek, with the uplands between the sources of these two streams and Five Lakes Creek. The altitude ranges between 6100 feet at the mouth of Squaw Creek to 7540 feet at the Five Lakes. Within this area is a great variety of situations and conditions: alpine meadows, swamps, barren cliffs, and forests of fir and pine. It is hoped that these notes may prove to be some slight contribution to the general knowledge of these interesting and lovely plants.

1. *Pyrola asarifolia.* In colonies, where a streamlet flows through a growth of willows or alders. It has a large round basal leaf, and flowers which in odor and appearance resemble those of the lily-of-the-valley, save that the corolla is tipped with rose. In bloom from middle to late July. Found on both sides of the Truckee River from the Lake to Deer Park station.

[1] Since the above was placed in the editor's hands, my attention has been called to a note in the *American Breeder's Magazine,* vol. 1, p. 262, to the effect that experiments with seedlings of *Pinus ponderosa* show "a decided twist of fibers from the time of germination," that is, before there could be any physical obstacles to determine its direction. And I also had recalled the remarkable cabling of the great roots of *Sequoia gigantea,* where the same thing would be true.

2. *Pyrola secunda.* A small plant forming colonies in situations not unlike those of No. 1, but a little more in the open. Corolla greenish-white, blooming in July. Found on the trail between the Lake and the Ramparts, and along the upper course of Squaw Creek.

3. *Pyrola minor.* In moist places. Plant smaller throughout than *P. secunda;* corolla greenish-white. In bud August 5th. Found in one place only, on the shores of the Five Lakes.

4. *Pyrola picta.* Dry woods. Easily known by its dark-green basal leaves with white veins. Flower-stalk about six inches high. Flowers pale, sometimes tinged with red, blooming in early August. In woods about the Tavern, and on the trail as far as Deer Park station.

5. *Pyrola pallida.* Often found growing with *P. picta,* and like it in appearance, save that it is pale throughout, and its leaves lack the white veining. It blooms late in July.

6. *Chimaphila umbellata.* Here and there in dry woods, often associated with Nos. 4 and 5. A beautiful plant about five inches high. Corolla pale pink, waxy, and very fragrant. Late July.

7. *Chimaphila menziesii.* In dry woods, forming colonies. A bit larger than *C. umbellata,* with which it is often associated. Corolla deep pink, waxy, and *not* fragrant. Blooms in early August. There is a fine bed of it on the trail between the Ramparts and Lake Tahoe.

8. *Sarcodes sanguinea.* Snow-plant. A saprophyte with thick fleshy stem, bright red throughout. Found in great abundance during the first half of July on the trail from the Lake to Deer Park and on the ridge above.

9. *Pterospora andromeda.* Pine Drops. A saprophyte with naked reddish-brown stalk, rising from one to four feet high among low underbrush. In late July. Here and there between the Lake and Mat Green's.

10. *Pleuricospora fimbriolata.* In dry woods. Has a thick stem about six inches high, bearing a dense cluster of flowers. A saprophyte; whitish throughout. Two specimens only were found blooming in July on the ridge above the trail between Deer Park and the Lake.

11. *Kalmia polifolia* var. *microphylla.* Pale American Laurel. In swampy ground. A shrub about six inches high, poisonous to cattle. Corolla lavender, very attractive. In bloom on the north side of Squaw Meadow early in July.

12. *Ledum glandulosum.* Labrador Tea. In moist or swampy ground. A shrub about four feet high, with showy clusters of white

flowers blooming on the north side of Squaw Meadow late in July, and on the shores of the Five Lakes in August.

13. *Bryanthus breweri.* American Heather. On exposed rocky slopes at high altitudes. A low spreading shrub with needle-like leaves and dark rose-colored corolla. The beauty of a slope of it in full bloom is like nothing else that I know. In bloom on the shores of the Five Lakes late in July.

14. *Arctostaphylos nevadensis.* Dwarf Mazanita. At high altitudes on level ground. A low creeping shrub forming extensive mats, and blossoming as soon as the snow leaves the ground. Flowers pale pink, in clusters. Abundant about the Five Lakes.

CALENDAR OF MEETINGS

September 18, 1915.—Regular meeting at the Oakland Public Museum. Dr. Jepson being absent for the year, Prof. P. B. Kennedy was elected president. Miss M. Alice King described her success in growing native plants in her home garden. Mr. Guy Smith discussed the need of an education extending beyond books to all the factors which make up the environment of the child, and the culture to be secured by the study of plant-life.

October 16, 1915.—The speakers were as follows: Prof. R. W. Stevens, "The Possibilities in the use of Berry-bearing Plants in Gardens and Parks"; Mr. W. S. Gould, "Growing Native Shrubs in the Oakland Parks"; Miss May Sellender, "How Berries and Berry-bearing Plants may be used in House Decoration."

November 20, 1915.—Prof. Walter Mulford gave an illustrated lecture on "City and County Forests for California," showing the excellent results secured by a careful system of forest-production carried on by cities and counties elsewhere, especially in Switzerland.

January 22, 1916.—Professor Kennedy spoke of the great importance and advantage to agriculture of a life-history herbarium of all our common plants, both indigenous and introduced, in order that they may be easily recognized in all their stages of growth. After discussion it was decided to ask the members of the Society to co-operate in building up such a herbarium. There followed an illustrated lecture by the president on the Kew Gardens and their vicinity.

March 11, 1916.—Prof. H. M. Hall gave a talk, illustrated by maps and herbarium specimens, on "Plant Life in the South Coast Ranges."

April 18, 1916.—Annual meeting, dinner, and election of officers, at Hotel Claremont, Berkeley. The officers elected were: President, Prof. P. B. Kennedy; 1st vice-president, Mr. Guy Smith; 2d vice-president, Dr. Wm. F. Badè; secretary-treasurer, Mrs. D. W. de Veer; corresponding secretary, Prof. C. B. Bradley.

May 13, 1916.—Lecture by Prof. John W. Gilmore on "Floral and Agricultural Practices in China."

June 17, 1916.—The lecturer announced for the evening being unable to keep his appointment, Prof. J. W. Gilmore generously gave another talk on "Agricultural Conditions in China."

September 9, 1916.—Illustrated lecture by Dr. R. Ruggles Gates, of the University of London, on "The Origin of Species by Mutation," with special reference to the genus Oenothera.

November 11, 1916.—Reports by members of observations made during their summer trips.

December 17, 1916.—Meeting at the home of Mrs. Harriet P. Kelley. Topic: "The Flora of the Tahoe Region," illustrated by herbarium specimens, and discussion by various members.

January 13, 1917.—Topic: "Conservation of Native Plants of the Bay Region.

March 10, 1917.—Talks by Mr. W. S. Gould on surviving specimens of *Quercus agrifolia* from the groves which once covered the site of Oakland; by Mr. C. W. Carruth on experiments in seeding and planting native plants in new stations; by Prof. W. S. Blasdale on Primroses, their types and variations; and by Mr. Guy Smith on the value of the study of plant-life in the education of very young children.

April 14, 1917.—Annual meeting, dinner, and election of officers, at Hotel Carlton, Berkeley. The officers elected were: President, Prof. P. B. Kennedy; vice-president, Mr. E. S. Heath; secretary-treasurer, Miss A. Bruce Walker; 1st corresponding secretary, Prof. C. B. Bradley; 2d corresponding secretary, Mr. C. W. Carruth. After the dinner there were speeches by Prof. C. B. Bradley, making a plea for appreciation and protection of our wild gardens, now in danger of annihilation; by Prof. H. M. Hall, outlining a line of research which the Society might undertake as to economic and commercial uses of native plants; and by Mr. E. S. Heath on "Enthusiasm."

REPORT OF FIELD TRIPS

April 4, 1915.—Thousand Oaks. Leader, Miss Walker. The field flowers of April, and especially *Calochortus.*

April 11, 1915.—Lomita Park, San Mateo Co. Leader, Mrs. J. B. Smith. The plants of that marshy district, especially *Floerkea douglasii* and *Ranunculus orthorhyncus.* Field preparation of herbarium specimens.

April 17, 1915.—Miss Garber's private grounds, Claremont Park, Berkeley. Leader, Miss Garber. The plants and shrubs under cultivation.

April 24, 1915.—Ingleside. Leader, Mrs. Inez R. Smith.

May 2, 1915.—Point Bonita. Leader, Mr. John A. Imrie. Comparative study of beach and marsh formations.

May 22, 1915.—A small area in the Oakland hills near Dimond Cañon. Leader, Mr. C. W. Carruth. Study of *Delphinium nudicaule* (Red Larkspur).

May 30, 1915.—Lomita Park. Leader, Miss M. Alice King. Plants of the seaward hills.

June 5, 1915.—Colma Cañon. Leader, Mrs. Inez R. Smith.

October 2, 1915.—Bay Farm Island. Leader, Mr. W. W. Carruth. Plants of the Salt Marsh formation.

November 6, 1915.—Beach at Fort Point. Leader, Prof. Setchell. Study of sea plants.

EXHIBITS

May 14-15, 1915.—Special exhibit of *Leguminosae.* Plants in season were shown in fresh bloom; those not in season were shown in herbarium specimens. All the genera native to California were represented, some of them in a goodly number of species. In addition, herbarium exhibits of several ecological formations were made by individual members.

October 16-17, 1915.—Exhibit of berries and berry-bearing shrubs. Separate sections were given to the native and the exotic species, and to scientific and artistic methods of arrangement and grouping. The exhibit proved to be one of the most attractive and popular that the Society had undertaken.

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VOLUME I NUMBER 4

MADROÑO

JOURNAL OF THE CALIFORNIA BOTANICAL SOCIETY

Contents

October, 1922

MADROÑO

JOURNAL OF THE CALIFORNIA BOTANICAL SOCIETY

The purpose of the Journal is, primarily, to publish articles and notes on the botany of the native plants of California; to furnish a medium of communication relating to measures in behalf of the preservation of the native flora, and to provide a record of the Society's meetings and activities. Notes upon the habits, life history or geographic distribution of the native plants will be especially welcome.

Back Numbers of the Journal may be had from the Assistant Secretary,

Mrs. Adeline Frederick,
1636 Woolsey St., Berkeley, Calif.

Manuscript for publication should be sent to

Dr. W. L. Jepson,
2712 Benvenue Ave., Berkeley, Calif.

Dues of members are $2.00 per year.

Mrs. Linda G. Dodd, *Treasurer*,
2636 Hillegass Ave., Berkeley, Calif.

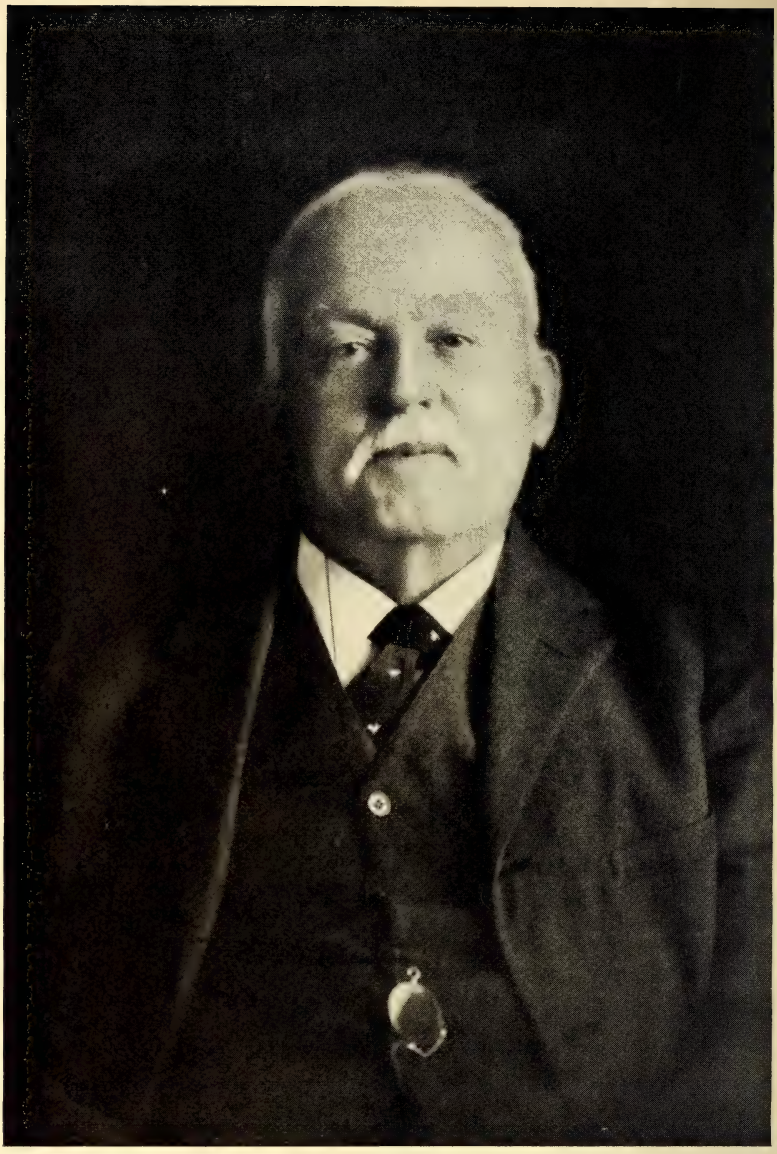
ANNUAL DINNER FOR 1914

THE annual dinner of the California Botanical Society for 1914 was held December 12 at the Hotel Carlton in Berkeley. Dr. W. L. Jepson presided as toastmaster and introduced Mr. S. B. Parish of San Bernardino, as guest of honor. A hearty welcome accorded the guest by the toastmaster was joined in by Dr. H. M. Hall and Miss Rosalind Keep. Mr. Parish responded as follows:

I confess, Dr. Jepson, to a feeling of surprise this evening when I look upon this goodly company that is before me, to see that there are so many botanists here in central California. I did not suppose there were. The most that I am accustomed to, when botanists gather together, is two or three, and to see so many is an agreeable surprise to me, and it must be very agreeable to you to know that there are so many interested in the subject. It must be very stimulating to you in your studies, and in your investigations of nature. It brings to my mind very prominently the last time I was in Berkeley. That was a generation ago, I am sorry to say—thirty odd years—and Berkeley at that time was not a botanical center by any means. I remember coming over from San Francisco in company with Dr. Parry, who was then staying there, to call upon the only working botanist in Berkeley. I suppose there was somebody up at the University, tho I do not know. But the only working botanist was the Rev. E. L. Greene, afterwards Professor of Botany in the University, but who was at that time rector of a little wooden church. It was a very small and plain structure—I do not remember where it was situated[1]—and I came over and attended the morning service and afterwards went with the rector to his home and we talked about plants the rest of the evening. That seemed to be the extent of botanical activity in Berkeley at that time. What activity there was on the coast of California at that time centered in San Francisco at the old Academy of Sciences, which then occupied a church at the top of the hill,[2] and the botanical department was located in the gallery of this old church. There were perhaps three or four persons in the Academy who were more or less interested in botany. Dr. H. W. Harkness, who was interested in fungi but who has left no impression on my mind, was one. Dr. Hans Behr, who was the best educated botanist of all, but whose interest in botany at that time had all turned to spiders. He cared not very much for plants, but was very much interested in spiders. The third botanist and the one who was working the most was Dr. Albert Kellogg, and I remember him very distinctly when one would go to the church

[1] St. Mark's Church, Bancroft Way.
[2] California Street.

MADRONO, vol. 1, p. 71-86, Sept. 30, 1922.



Samuel Bonsal Parish

and climb to the gallery. At one end you would see Dr. Kellogg in his shirt sleeves and his old red flannel waistcoat, making drawings of twigs. He would lay the twigs down on the table, and over them he placed a sheet of glass, and over that a piece of transfer paper, and very slowly, very deliberately, and very patiently he would trace out the drawings of these plants. I do not know how many he had. He must have had a great many, and most of them were destroyed at the time of the great earthquake I suppose. How was that, Dr. Jepson? [Dr. Jepson: Yes, they were all destroyed.] Then there was Mr. Harford who worked with Dr. Kellogg more or less. The herbarium which they had was not very extensive, and more or less the work of Kellogg and Harford. However, they had the best collection of books and the best collection of plants on the coast, and it was very interesting for anyone who cared for plants to go up there and see what there was. That was the botanical center then. One goes to the universities now. I believe that the Department of Botany in the University of California is dissatisfied by not having a building of its own, but it seems to me the men are very finely conditioned. They have a fine collection of plants and plenty of books. I can find almost any book there I chance to need. Then there are visiting botanists working there much of the time. Anyway there is this that they have in common with the old days—the kindly generous spirit which they show to visitors, throwing open their herbarium and their library and assisting them in every way that they can— the same spirit that was in that little gallery over at San Francisco.

Now I said it was very encouraging, most encouraging to you ladies and gentlemen, to have the spirit of numbers. It is all very well to talk about holding communion with nature alone, but it seems to me that is not the case to which the old proverb refers—that two are company and three are none. It seems to me a matter of great importance—this spirit of numbers— and that is one of the disadvantages in living away from a botanical center. I have been perhaps more fortunate in the place in which I reside than I might have been had I resided elsewhere. I live at a place which is really a very interesting natural botanical center. We are within a couple of hours of the seashore and within a short distance of the desert and we have, immediately overhanging the San Bernardino valley, mountains 12,000 feet high. Thus we have all kinds of vegetation and thereby this region attracts botanists, and so I have had the pleasure of seeing there a great many botanists who have come to visit my region; first, perhaps, Dr. Asa Gray, a botanist of America whose work is at the foundation of all systematic botany in this country. Dr. Gray made two visits to California as you are all probably aware. The time I saw him was at the second visit and he was then some sixty-five or seventy years old, and was not feeling very well. His great trouble was that he was unable to climb these mountains, 12,000 feet high, at the time of his visit because they

were covered with snow, and he regretted that he was there early in the season.

Another botanist that I recall, with others, is Dr. Engelmann. It seems to me that he was a model for the unprofessional botanist. Dr. Engelmann was a physician in a very large and extensive practise. Yet he found time to take up several of the most difficult families of plants and those which required the closest study, and to make himself an undisputed authority with regard to them. His work still remains, at least at the foundation of whatever is being done with these plants at the present time.

There were a great many others and I perhaps may mention just one or two more. I should like to speak to you about Mr. Pringle, who occupies as a collector as permanent a position as Dr. Gray did as a systematic botanist. Mr. Pringle collected very extensively in California and other parts of the United States; he then confined his attention to the flora of Mexico and for twenty-five years spent his summers collecting in different parts of that country, collecting altogether in Mexico one-half million of plants. And when you think of the amount of labor involved in that you will say that he was persistent and—well, persistent I guess is about the best word—that he was persistent. He made fifty sets of every plant and distributed them to the principal herbaria of the world. Now, a man that will keep at that for twenty-five years certainly deserves the name of a great collector. I shall tell you just a little about his life and give certain incidents which illustrate the spirit of the man, the persistence and determination of the man. Pringle was born, I suppose that is the way they come,—he was born a real true Presbyterian. When he came to the years of discretion he met a young lady of Quaker faith and became a very strong Quaker with all the peace loving propensities of Quakers and a disposition which perhaps leads them into the most severe combats that anyone can meet. They are bound to obtain peace under any conditions. Unfortunately, soon after he became converted by this young lady, it was time for the Civil War, and he was drafted for a soldier. By the payment of three hundred dollars he could have remained at home, but principle was too much for that and he refused to pay this fee for a substitute. He was sent to the recruit camp, absolutely refused to carry a gun and defied the United States and its power and authority. All the gentle measures which military men are accustomed to use in such cases they freely used. I think you would be interested if you could read some extracts from his diary on that account. It seems to me to carry you back about five hundred years to things that occurred in England at that time. However, when they found that they could do nothing else with Mr. Pringle they decided to detail him as a nurse. That created a momentary hesitation, but conscience was too strong and he determined that he would not go to war even to that extent. He could not be made to do anything so far away in spirit from the ways of peace. Well, how

do you suppose it all came out? It came out that President Lincoln heard of it and gave Mr. Pringle a furlough with orders to report whenever he was called and of course he was never called upon. Mr. Pringle overcame the United States government and I doubt if there is another botanist that could do it. That persistence and courage led him perhaps all through his life. He went back and married the young lady and I wish I might say they lived happily ever afterward, but it ended in a divorce.

Well, I might go on and tell you about many other botanists, but I think I have told about enough and I thank you very much. It is a very great pleasure to both Mrs. Parish and myself to be with you this evening.

A NEW SPECIES OF CYPRESS

Willis Linn Jepson

Cupressus Forbesii Jepson n. sp. Slender tree 15 to 20 ft. high; bark very smooth, shining, red-brown or even dark cherry red; branchlets squarish; foliage bright green; dorsal pits of leaves minute or commonly wanting; cones globose, ¾ to 1 1-5 in. long; seed red-brown.

This cypress was discovered Dec. 30, 1907, in Cedar Cañon between El Nido and Dulzura, San Diego County, by my former student, Mr. C. N. Forbes, later Assistant in Botany, Bishop Museum, Honolulu. I take pleasure in naming it in his memory. The same thing, apparently, has also been found on Mt. Tecate and near Pala by Mr. S. B. Parish but I have not seen his specimens.

NOTES AND NEWS

Professor J. H. Patton, of the University of Melbourne, visited the University of California in September. He voiced surprise at the size and growth of the Blue Gums (Eucalyptus globulus) in the Hilgard Grove on the University campus and remarked: "We have none as tall in our own state of Victoria. There must be something very mild about your winters and something equable about your whole year that gives such growth. We grow your Monterey Cypress as a lawn tree for its pyramidal shape and also as a hedge for clipping. Lawson Cypress we also grow as well as Monterey Pine. Monterey Pine does well and we use its wood for making cheap packing cases."

From Professor Patton it was learned that Baron Ferdinand von Mueller's collection is utterly neglected. It is housed in its original herbarium building about ten miles from the University of Melbourne, the fine library still with it. This establishment, for such it once was, does not belong to the University and does not belong to the Botanic Garden, just outside of which it stands.—W. L. J.

The Cornell Botanical Expedition, after a trans-continental trip from Ithaca, New York, arrived in California over Mt. Shasta in September. The party consisted of nine persons traveling in three machines. Three thousand specimens were collected and almost as many species. Dr. K. M. Wiegand headed the expedition. A portion of the party under the guidance of Dr. W. L. Jepson made a trip to the great redwood groves of the South Fork Eel River, studying especially the stand on the Bull Creek flats where are the tallest of the Earth's trees.

Dr. Olof Arrhenius visited the University of California in August. During a discussion of the outlook for botany he said: "I am surprised at the little time you in American universities have for research. It is too bad that botany is not regarded in America as a practical science. I notice that public opinion has so much to do with what is given in the University. But what does public opinion know about the needs of the sciences of Physics, Chemistry and Botany? We have disadvantages at home—but public opinion does not control the universities. The universities should be independent—for scholarship and research."—W. L. J.

REVISION OF THE CALIFORNIA SPECIES OF THE GENUS ARCTOSTAPHYLOS

Willis Linn Jepson

Hooker and Arnott in the Botany of Beechey's Voyage (1832) record only two manzanitas from California, the two being recorded as unnamed varieties of Arctostaphylos tomentosa. In the Botany of California (1876) Gray described eight species of Arctostaphylos exclusive of Comarostaphylis. In the Synoptical Flora (1878), Gray has for California eleven species and one variety. In the North American Flora (1914), under the generic name Uva-ursi, Abrams recognizes as Californian, twenty-two species but no varieties. In the treatment here presented twenty-three species and eight varieties are recognized, but certain species reduced in the North American Flora are retained as valid.

The segregation of Californian Arctostaphyli into recognizable and satisfactory units presents difficulties. Leaves, flowers and fruits are very uniform in the genus and largely without strongly marked or distinctive morphological characters. The various species as here evaluated differ most obviously in habit and in what may be termed vegetative characters—in stature, in pubescence or glandulosity or lack of these, and also in hue of foliage. These characteristics or adaptations on the whole seem to be specific and rather decisive, and the main types as one sees them in the field, particularly in the Sierra Nevada, usually represent recognizable units which are commonly very distinctive in appearance. The extensive formations of the white Arctostaphylos viscida give a

cast to the scenery which is very different from the tone of the green colonies of Arctostaphylos patula, whilst both, forming impenetrable thickets, have nothing habitally in common with the rough mat of Arctostaphylos nevadensis over which one may walk. Each of the various units in the Sierra Nevada, moreover, is restricted to a certain zone or topographic area, capable of being rather definitely defined in terms of climate and altitude, that is to say they are habital units fairly in harmony with the physical factors. In the Coast Ranges the segregation of Arctostaphylos units presents a more embarrassing complex, since changes in soil and climate are more local and more multiplied and involved.

The evaluation of the species in this paper rests upon a basis different from that hitherto employed in this genus. Important weight is given to the character of the pubescence on the peduncles and pedicels of the inflorescence and on the foliage, to the glandulosity or the lack of it, to the hue of the foliage, and to the nutlets. Altho commonly thought of as unstable or ecological the pubescence and its character give in this genus useful and often dependable differentiae, as well as the glandular character or its absence. While the definition of species on the basis of such minute characters is scarcely ever satisfactory the species in this case have, in a most interesting way, been stabilized by support derived from neglected but yet striking facts of their life history. In other words, the species as segregated by the characters above indicated, are further fortified by the facts of their biological reaction to fire and this character, it is to be emphasized, does not cut across the characters described above and used as initial differentiae, but parallels them closely. Certain species are killed completely by chaparral fires and depend exclusively upon seed for regeneration in their area. Other species crown-sprout after fire and develop in various ways heavy root crowns or broad tabular structures at the surface of the ground. In small groups of closely related species, groups so close that the component units have been defined only by critical reference to the minute characters of pubescence and glandulosity—the units of such groups will nevertheless show the strongest difference in their reaction to destructively high temperatures in a chaparral fire and display decisive cleavages which parallel the somewhat obscure structural differences.

1. A. GLAUCA Lindl. The characters of recognition for this species are its glaucous foliage, large viscid berries and globose stones, the last being a very striking mark. While the large solid smooth stones are very characteristic, small almost spindle-shaped stones acute at each end may sometimes be found on the same shrub with fruits containing large globose stones. Again an entire shrub may bear only the former type of stone. This state appears in some cases at least to be connected with under-nutrition.

Arctostaphylos glauca is common in Southern California and is not infrequent in the inner South Coast Ranges. It has sometimes

been reported from the North Coast Ranges, but thus far only on the basis of mistaken determination.

In the lower part of Mill Creek Cañon, San Bernardino Mts., I measured in 1913 an individual 22 feet high with its short trunk 1 foot 1 inch in diameter. In September, 1920, I measured the large individual which stands on the trail up the ridge backbone from Donner Cañon to Cold Spring below the saddle of Mt. Diablo. It is 18 feet high, 24 feet broad across the crown, the trunk 21 inches in diameter at 4 inches above the ground. This is a remarkable tree.

Locs.—Las Trampas Ridge, Contra Costa Co., *Jepson* 6853; Donner Cañon, Mt. Diablo, *Jepson* 7592 (this and the next two have glandular-pubescent pedicels); Cedar Mt., Mt. Hamilton Range, *Jepson* 6219; Peachey Cañon, San Luis Obispo Co., *Barber* a3; Santa Inez Mts. (acc. Abrams in N. Am. Fl. 29:101); Arroyo Seco, near Los Angeles, *Braunton* 790; San Antonio Cañon, Claremont, *C. F. Baker* 4013; Mill Creek, San Bernardino Mts., *Jepson* 5587 (pedicels viscid-glandular); Indian Cañon, Collins Valley, *Jepson* 8857; Warner Ranch, *Jepson* 8527; Cuyamaca Mts., *Palmer;* San Diego, *Mary F. Spencer.*

Var. EREMICOLA Jepson n. var. Leaves purple-veined; berry elliptic.—Piñon Well Mts., n. Colorado Desert, *Jepson* 6004.

Refs.—ARCTOSTAPHYLOS GLAUCA Lindl. Bot. Reg. sub. t. 1791 (1836), type from Cal., *Douglas;* Jepson, Fl. W. Mid. Cal. ed 2, 314 (1911). Var. EREMICOLA Jepson.

2. A. VISCIDA Parry. This species forms a broad band in the Sierra Nevada foothills from Shasta Co. to Tulare Co., but with a break in the band between the Stanislaus and Kings rivers, which is occupied by the closely allied A. mariposa Dudley. This interruption in the distribution can now only be stated broadly and its exact limits and the nature of it will eventually be more definitely defined. This species is however the most characteristic and widespread member of the genus in the Sierra foothills and is now reported from the inner North Coast Ranges. Its deep-red small berries are either viscid or not viscid in a given locality and indeed viscid and non-viscid berries may sometimes be found on a single shrub. It forms extensive exclusive or nearly exclusive colonies, the individuals of which are often densely massed.

Locs.—Sierra Nevada: North Fork Tule River (berry viscid), *Jepson* 4702, 4720; Middle Tule River, *Jepson* 4861 (berry viscid); Mokelumne Hill, *Blaisdell;* Shingle Sprs., *F. B. Herbert;* Rough and Ready, Nevada Co., *Jepson;* Oroville, comm. *A. E. Wieslander;* Cow Creek Mts., Shasta Co., *Baker & Nutting.* Coast Ranges: Oro Fino, Siskiyou Co., *Butler* 659, 693; Klamathon, Siskiyou Co., *Copeland* 3519 (berry not viscid); Dunsmuir, *Jepson*; Delta, *Jepson* 6178 (berry not viscid); Greasewood Hills, w. Tehama Co., *Jepson;* Red Mt., n. Mendocino Co., *Eastwood;* Lake Co., *K. Brandegee* (berry viscid); Knoxville Ridge, *Jepson* 9047; Moore

Creek, Howell Mt. (berry viscid), *Jepson* 6826, 6840; Chiles Mill, Chiles Creek, *Jepson* 9067.

Ref.—ARCTOSTAPHYLOS VISCIDA Parry, Bull. Cal. Acad. 2:492 (1887), type loc. Ione, Amador Co., *Parry* (Mar. 9, 1887).

3. A. MARIPOSA Dudley is very closely related to A. viscida. It is distinguishable from that species by its glandular-hairy branchlets, peduncles and ovary but the differentiae are sometimes difficult to apply. Both are white-foliaged manzanitas of the same size and method of branching. A. mariposa may not be eventually sustainable as a species. Its inflorescence is, however, remarkably glandular—so glandular that it is noticeable that the flowers stick to the clothing of travelers passing through the chaparral.

Locs.—Columbia, *A. L. Grant* 627; Yankee Hill, *Jepson* 6450; Confidence, Tuolumne Co., *Jepson* 7695; Big Creek, Big Oak Flat road, *Jepson* 8341; Mariposa, *Congdon;* El Portal, *Jepson* 5671; Tehipite Valley, *Hall & Chandler* 491.

Var. BIVISUM Jepson n. var. Leaves dark green, 1½ to 2½ in. long; branchlets, glandular-hairy and somewhat dusky; berries whitish with a somewhat transparent or lucent quality.—Yosemite Park: near Wawona, *Jepson* 5658; Hetch-Hetchy, *Jepson* 3452 (type).

Refs.—ARCTOSTAPHYLOS MARIPOSA Dudley; Eastw., Sierra Club Publ. 27:52 (1902), type loc. "Millwood and King's River Cañon," *Eastwood.*

4. A. PATULA Greene grows at higher altitudes than any of the preceding species. It inhabits the Yellow Pine belt in all the higher ranges of California and also spots the cañon tali with low dark green dots on a white granite ground. It is commonly the only species in its area or the only erect species. It is remarkable for its bright green glabrous leaves reminiscent of A. stanfordiana. Its berries are medium sized, glabrous, and usually though not always very hard when mature. The root develops into a globose or carrot-shaped structure which crown-sprouts after fire or mutilation. It does not form a broad root-crown structure like A. glandulosa. The branches are often weighted down by winter snow and these at their depressed bases often root by adventitious rootlets. Indeed after fire this species spreads in circles in this way.

A. patula has the widest range of any Californian species and is most abundant in individuals. It is remarkably uniform in habit and in technical characters throughout its range.

Locs.—Sierra Nevada: McCloud, *Jepson* 5743; Upper Fall River Valley, *Jepson* 5775; Susanville, *Jepson;* Johnstown, *L. S. Smith;* Taylorsville, Plumas Co., *Jepson* 8017; Plumas Co., *Platt;* Brush Creek, Butte Co., *Kate Conger;* Sierraville, *Jepson;* Mt. Tallac, *Jepson* 8132; American River, *Kennedy* 158; Bald Mt., near Sonora, *A. L. Grant* 667; Strawberry, Tuolumne Co., *A. L. Grant* 22; Glacier Pt., Yosemite, *Jepson* 5659; Patterson Mt., Fresno Co., *A. E. Wieslander;* Millwood, *Jepson* 2778; Wawona (towards

Mariposa Grove), *Jepson* 5645, 5653; Whitney Creek, *Jepson* 1100; Garfield Forest, South Fork Kaweah, *Jepson* 4664; Kern Lake, *Jepson;* Lloyd Mdws., Kern River, *Jepson* 4891; Cottonwood Creek, Inyo Co., *Jepson.* North Coast Ranges: Shasta Retreat, *Butler* 640; Dunsmuir, *Jepson* 6163; Weed, *Butler* 657; Sisson, *Jepson* 5787; Edgewood, *Kisling;* Trinity Summit, *Jepson* 2062; South Yollo Bolly, *Jepson;* Mt. Hull, *Hall* 9567. Southern California: North Baldy, *Peirson* 143; divide betw. Bear Valley and Santa Ana Cañon, *Parish* 19288; Mill Creek, San Bernardino Mts., *Jepson* 5589; Mt. San Jacinto, *Hall* 2419. Glenbrook, Douglas Co., Nev., *C. F. Baker* 1001; Ash Cañon, Ormsby Co., Nev., *C. F. Baker* 979 (branchlets slightly canescent). Var. INCARNATA Jepson n. var. Corolla pink, its lobes erect.—Sacramento River Cañon (Dunsmuir, *Harriet P. Kelley,* type.)

Refs.—ARCTOSTAPHYLOS PATULA Greene, Pitt. 2:171 (1891), type spms. from central Sierra Nevada (Calaveras Co. to Fresno Co.); Merriam, N. Am. Fauna, 16:157 (1899). *A pungens* var. *platyphylla* Gray, Syn. Fl. 2:28 (1878), type from Cal.

5. A. STANFORDIANA Parry is related to A. patula Greene on the one hand and to A. manzanita Parry on the other. Its root-system is rather superficial like that of A. manzanita, and it does not form heavy or globose root-crowns as does A. patula. It is distinguishable from A. manzanita by its smaller size, more erect habit, glabrous leaves and usually glabrous rachis and by the remoter bractlets of the raceme. It favors the mountain summits and higher ridges of the central North Coast Ranges, and thus commonly grows at higher altitudes than A. manzanita, though not found beyond the horizontal range of that species. It is remarkable for its clean trim habit. The leaves are just alike on both sides. The small berries are very irregular in shape, as if without definite form, or typical only in deformation. A few individuals of it have recently been discovered on Mt. Diablo, about half-way up the south slope.

Locs.—Mt. Diablo, *Jepson* 9653; Moore Creek, Howell Mt., *Jepson* 6827; La Jota Plateau, Howell Mt., *Jepson;* Mt. St. Helena, *Jepson;* Scotts Valley, Lake Co., *Tracy* 1698; Mendocino Range, sw. of Ukiah, *Jepson* 7629; Bartlett Mt., *Eastwood;* Red Mt., n. Mendocino Co., *Eastwood;* Round Valley, *Westermann;* Red Rock, ne. of Round Valley, Mendocino Co., *Jepson.*

Refs.—ARCTOSTAPHYLOS STANFORDIANA Parry, Bull. Cal. Acad. 2:493 (1887), type loc. Napa Range near Calistoga, *Parry;* Jepson, Fl. W. Mid. Cal. 371 (1901), Univ. Cal. Mag. 2:102 (1896).

6. A. ELEGANS Jepson, though collected three decades since, is still known only by the original collection. It is not related to A. manzanita but is near A. stanfordiana in character of foliage and branchlets.

Ref.—ARCTOSTAPHYLOS ELEGANS Jepson, Erythea 1:15 (1893), type loc. obsidian slopes southerly from Mt. Konocti (Uncle Sam

Mt.), Lake Co., *Jepson*. The note in Erythea, 3:178, was an inadvertence.

7. A. PUNGENS H. B. K. This species is not uncommon on the plateau of Mexico at 7000 to 8000 feet. It ranges northward through Arizona into California, at constantly decreasing altitudes as it moves northward, though keeping to the tops of the mountains. With us it appears to be rather rare, but its range is in harmony with the geographic distribution of plants entering California from the southward.

It is to be pointed out that material from California referred to A. pungens is with difficulty differentiated from A. manzanita. A. manzanita, however, occupies a distinct geographical area; and it is retained as a species because it represents a different phase from A. pungens in our manzanita series.

The following specimens from California can be cited as examples: Onstatts Valley, San Jacinto Mts., *Hall;* Pecacho Peak, s. Benito Co., *Hall* 9947. The plants of Marin Co. (which grow along the high ridges of the Mt. Tamalpais region and which have been known as A. montana Eastw.) agree well in pubescence, leaves and other characters with the Southern California specimens just cited and I hold them to be conspecific. Some of them show well, tho not in the extreme form, the characteristically short and abrupt but very sharp point to the leaf apex (Rock Spr., *Jos. Saunders;* Mt. Tamalpais, *Jepson* 4761; Bill Williams trail, *Jepson* 9504); in other specimens this structure is less marked (Lagunitas, *Chestnut & Drew;* near Cypress Grove, Mt. Tamalpais, *Jepson* 6806), just as in some of the specimens from Mexico.

Fine examples of this Marin Co. form as it occurs on Mt. Tamalpais may be seen along Bill Williams trail between the Mountain Theater and West Peak. One individual is fairly typical and is noteworthy for its size and remarkable for its habit of growth. This individual is quite erect, 6½ feet high, and with an open crown recalling A. manzanita. After having attained its height maturity, it then, under some stimulus, threw out elongated lateral stems from the trunk base. These strong stems are very long, very densely branched in the top, and form or complete a low broad crown to the shrub, gently sloping to the ground from the center. The shrub as thus amplified is 24 feet in diameter and very thick and smooth, except in the center occupied by the original or first erect growth.

Although out of harmony with the general distribution in California, a specimen from Big Silver Creek, El Dorado Co. (*Kennedy* 228), is included here with some doubt.

Refs.—ARCTOSTAPHYLOS PUNGENS H. B. K. Nov. Gen. & Sp. 3: 278 (1819), type loc. mt. slopes near Mexico City. *A. montana* Eastw. Proc. Cal. Acad. ser. 3, Bot. 1:83 (1897), type loc. trail betw. Eldridge grade and Larsens, Mt. Tamalpais, *Eastwood;* l. c. 1:127 (1898).

8. A. MANZANITA Parry is the largest species of the genus, though the trunk of A. glauca may sometimes become as massive. In the Napa Range A. manzanita forms interesting pigmy forests 8 to 14 feet high on the lower western slopes of Howell Mt. Sometimes it is massed in closed stands, appearing as smooth as a meadow floor when seen from above. In more open situations the individuals become 13 to 22 feet high. In Lyons Valley on the westerly slope of Howell Mt. measurements of three especially large individuals were secured: *a*. Near Stingy Stile, Eden trail to Adam and Eve, height 15 ft.; trunk 4 ft. high before branching into 4 arms; trunk diameter at 3 ft. above ground, 1 ft. 2 in. *b*. Shoulder of hill to right of trail, 35 yards easterly from Stingy Stile, height 18 ft.; trunk 2 ft. high before branching into 5 arms; trunk diameter at 1½ ft. above ground, 1 ft. 2 in. *c*. On the little ridge to west of Lyons Valley, tree by path, height 22 ft.; trunk 1 ft. 8 in. before branching into 2 arms; smallest trunk diameter (at ground) 11⅔ in.

Arctostaphylos manzanita is killed outright under chaparral fires. One sees the dead bodies of these arborescent shrubs, 8 to 15 feet high, standing like white skeletons in the fire-burns of chaparral areas, for they soon lose their red-brown bark and reveal the white sapwood beneath. While shallow-rooted, they are not as shallow-rooted as A. stanfordiana, the bodies of which are overthrown in the first winter storms. A. manzanita on the other hand may stand for some years, but finally the roots decay and a touch will send an individual crashing to the ground.

Arctostaphylos manzanita, therefore, reproduces exclusively by seed. It is an aggressive species. At the present time, in the centers of its greatest development, it is invading new areas or recovering old ones. Along the Napa Range and in Mendocino Co. considerable slopes on the lower hills were cleared thirty to forty years ago for cultivation or grazing. Within ten or fifteen years much of this land has been permitted to revert to primitive conditions. Seedlings of this species appear in large numbers in these neglected fields or old vineyards, as they do also on burns. Such seedlings represent a cumulative crop of seeds—perhaps ten to forty years— and indicate the long persistent vitality of the seeds.

Along the lower slopes bordering the valleys of central Mendocino Co., about Ukiah Valley, and particularly from Long Valley to Cummings, Arctostaphylos manzanita is abundant. It occurs mostly below the open stand of Quercus kelloggii and Pinus ponderosa, covering the bases of low hills which border the narrow valleys and colonizing the opens and flats. From Cummings one may follow it westward to the headwaters of the South Fork Eel River in western Mendocino Co. where it occurs near Piercey sta. In the inner Coast Range it is less frequent or rare, but is found on Mt. Diablo; summit of the Vaca Mts.; and near Jerusalem Valley, Wilbur Sprs., and Indian Valley—all in eastern Lake Co. In the Sierra Nevada foothills it occurs from Tehama Co. south to Tuo-

lumne Co. Definite stations in the Sierra Nevada are now for the first time indicated.

The binomial Arctostaphylos manzanita has been made to do duty over too wide a range; indeed it has been applied to other species in all parts of California. It is, however, one of the most definite of our manzanitas and is as yet known only from the foothills of the North Coast Ranges towards the interior and the Sierra foothills from Tuolumne Co. northward. It also occurs locally on Mt. Diablo.

Locs.—Coast Ranges: cañon at head of Sycamore Creek, Mt. Diablo, *Jepson* 9660, 9736; Gates Cañon, Vaca Mts., *Jepson* 2331; Howell Mt. foothills, *Jepson;* Mt. St. Helena, *Jepson* 7669; Jerusalem Valley, se. of Lower Lake, *Jepson;* Wilbur Sprs. and Indian Valley, ne. Lake Co., *Jepson;* Hough Sprs., *Jepson* 9005; Blue Lakes grade to Ukiah, *Jepson;* Elk Mt., n. Lake Co., *Tracy* 2352; Willow Creek, Trinity River, *Tracy* 3449; Asa Bean Ridge, ne. Mendocino Co., *Jepson;* Greasewood Hills, w. Tehama Co., *Jepson.* Sierra Nevada foothills, 500 to 3500 feet (in association with Quercus douglasii): Los Molinos, *Harriet P. Kelley;* Shingle Sprs., El Dorado Co., *F. B. Herbert;* Amador Co., *Hansen;* Gwin Mine, Calaveras Co., *Jepson* 1796; Copperopolis, *Davy* 1363; Columbia, *Jepson* 6397.

Var. APICULATA Jepson n. var. Berry with a short conical apiculation.—Head of Weldon Cañon, Vaca Mts., *Jepson* 7198 (type).

Refs.—ARCTOSTAPHYLOS MANZANITA Parry, Bull. Cal. Acad. 2:491 (1887), type loc. Napa Range near Calistoga, *Parry;* Jepson, Fl. W. Mid. Cal. 371 (1901).

9. **A. pastillosa** Jepson n. sp. In the higher foothills of the Sierra Nevada a manzanita occurs in a belt between that of A. viscida below and A. patula above. It is a vigorous shrub and has large berries which in shape and often in hue suggest the loaves of bread seen in bake-shops in Italy. It ranges from Placer Co. to Tulare Co. The formal diagnosis appears below.

Locs.—Cold Spr., North Fork Tule River, *Jepson* 4704; Strawberry, Tuolumne Co., *A. L. Grant* 888; Cold Spr., Tuolumne Co., *Jepson* 6456 (type); Bald Mt. near Sonora, *A. L. Grant* 666, 553; Yankee Hill near Columbia, *A. L. Grant* 598; Shingle Sprs., *F. B. Herbert.*

A. MEUKKA Merriam, Proc. Biol. Soc. Wash. 31:101 (1918), type loc. ridge between North Fork American and Bear Rivers above Colfax, *Merriam.* The life history of this species is too insufficiently described to be placed with certainty in this series as here arranged. The specific name, borrowed from the Miwok tribe, seems barbarous. Dr. Johnson once said, however, that no language is barbarous to the person to whom it is native. Dr. Merriam has cultivated Indian lore and tribal habits so long that *meukka* to him is probably as pleasing as the lucent phrases of the Ars Poetica to the ear of Horace.

10. A. NEVADENSIS Gray is a low species, analogous to Ceanothus prostratus Benth. in the Rhamnaceae, though not as completely prostrate, but growing like it on the floors of the open pine woods. Its main stems, prostrate and rooting, are ½ to 2 feet long and bear ascending or erect branchlets 3 to 4 inches high or up to 6 or 9 inches high. It occurs in the high North Coast Ranges and in the Sierra Nevada but is rare south of Mariposa Co.

Locs.—Sierra Nevada: Summit, Nevada Co., *Jepson;* Tahoe, *Katharine Chandler;* Mt. Tallac, *Jepson* 8136; Bierstadt Peak, *Davy* 3181; McClure Fork, Merced River, *Jepson* 3223; Glacier Pt., *Jepson* 5678; Bald Mt., Fresno Co., *Hall & Chandler* 414; Mt. Moses, *Purpus* 1369. North Coast Ranges: Hull Mt., *W. W. Mackie;* Soldiers Ridge, ne. Mendocino Co., *Jepson;* South Fork Mt., Humboldt Co., *Chestnut & Drew;* Trinity Summit, *Jepson* 2047; Marble Mt., *Chandler* 1598; Mt. Shasta, *Jepson.*

Ref.—ARCTOSTAPHYLOS NEVADENSIS Gray, Syn. Fl. 2:27 (1878), type loc. Sierra Nevada, 8,000 to 10,000 ft.

11. A. HOOKERI Don is a small coast species, that is very weakly represented, occurring from San Francisco Co. to San Luis Obispo Co. It was the first species of this genus to be described from California, at least with California definitely indicated as the place of origin. The type specimens were collected by Lay & Collie at Monterey and are now in the National Herbarium, British Museum. They seem to me representative of the natural type.

Locs.—San Francisco, *Kellogg;* Pajaro Hills, *Chandler* 430; Carmel, *Jepson* 2615, 2616.

Refs.—ARCTOSTAPYLOS HOOKERI Don, Gen. Syst. 3:386 (1832), type loc. Monterey, *Lay & Collie. A. franciscana* Eastw. Bull. Torr. Club, 32:201 (1905), type loc. Laurel Hill, San Francisco, *Eastwood.*

12. A. UVA-URSI Spreng. is a boreal species which extends south along the Pacific Coast and occurs in California along the north coast, growing in the sand-dunes of Mendocino and Humboldt Counties.

Locs.—Gaulala, *Brandt;* Fort Bragg, *W. C. Mathews;* Samoa, Humboldt Co., *Davy* 6184.

Refs.—ARCTOSTAPHYLOS UVA-URSI Spreng. Syst. 2:287 (1825). *Arbutus uva-ursi* L. Sp. Pl. 395 (1753), type locs. n. Europe and Canada.

Var. COACTILIS Fern. and McBr. Rhod. 16:212 (1914), type loc. Brunswick, Me., *Chamberlain;* this variety is attributed to California but the characters seem too indefinite as applied to our north coast specimens.

13. A. PUMILA Nutt. is a local species on the sand-dunes and mesas of Monterey Bay. It has much the habit of A. nevadensis, that is, it is low, about 4 to 8 inches high, and forms rough mats a few feet across.

Locs.—Monterey, *Jepson* 5702; Del Monte Heights, *F. G. Woodcock;* Seaside, *F. G. Woodcock.*

Ref.—ARCTOSTAPHYLOS PUMILA Nutt. Trans. Am. Phil. Soc. ser. 2, 8:266 (1843), type loc. Monterey, *Nuttall.*

14. A. NUMMULARIA Gray is a dwarf of the flat "pine barrens" of the Mendocino coast, and is associated with dwarf states of Pinus muricata and Cupressus pygmaea. This species does not, I think, crown-sprout, but after fires seedlings appear abundantly on its area. Mr. Carl Purdy tells me that these seedlings flower the second year.

Locs.—Fort Bragg, *Jepson, W. C. Mathews;* Mendocino City, *Bolander* 4749; Albion, *Davy & Blasdale* 6068.

The plant of Amador Co., described by Parry as A. myrtifolia, does not seem specifically distinct and it is here disposed as var. MYRTIFOLIA Jepson n. comb.

Locs.—Ione, *K. Brandegee;* betw. Ione and Buena Vista, *Congdon.*

Refs.—ARCTOSTAPHYLOS NUMMULARIA Gray, Proc. Am. Acad. 7:366 (1868), type loc. Mendocino plains, *Bolander.* Var. MYRTIFOLIA Jepson. A. *myrtifolia* Parry, Pitt. 1:35:(1887), type loc. ridges e. of Ione, *Parry.*

15. **A. sensitiva** Jepson n. sp. is a medium-sized erect shrub 3½ to 5 feet high. It grows on Mt. Tamalpais, and has passed hitherto under the name A. nummularia. The true A. nummularia Gray of the Mendocino coast is a low or almost mat-like plant. Arctostaphylos sensitiva is very shallow-rooted and is one of the most remarkable of all species of the chaparral in its relation to fire. The individuals are completely killed in chaparral fires and do not crown-sprout. In very intense fires the shrub may be completely consumed; in fires of less intensity or governed by suddenly changing air-currents a shrub may be killed by the high temperature generated in its vicinity without any evidence associated with destruction by fire. Such shrubs, retaining all their leaves, but with the foliage brown and dead, stand on the margin of fire-swept bands in the chaparral, as if suddenly electrocuted without any visible sign of injury to the plant as a whole. The shallowness of the root-system increases measurably the chances of its mortality in running fires. It tends to colonize exclusively small areas on Mt. Tamalpais. After fires it reappears promptly on "burns," and fruits at the age of five or six years. It thus adapts itself to short fire-intervals and is a true fire-type shrub.

Locs.—Mt. Tamalpais, *Jepson* (type), *Herbert & Wieslander;* betw. Butano and Little Butano creeks, Santa Cruz Mts., *Dudley.*

Refs.—ARCTOSTAPHYLOS SENSITIVA Jepson. *A. nummularia* Jepson, Fl. W. Mid. Cal. 370 (1901), not of Gray.

16. A. CANESCENS Eastw. This species, here regarded as valid, is reduced in the latest revision of this genus (N. Am. Fl. 29:97,—1914) to A. tomentosa Lindl. A. tomentosa is a species of the Washington and Oregon coasts which ranges into California along the north coast. A. canescens inhabits the summits of the middle Coast

Ranges and never comes down to the immediate vicinity of the coast as does A. tomentosa. The latter has characters which distinguish it from A. canescens aside from the differences between the two as to reaction to fire.

A. tomentosa is a medium-sized dark green shrub; it has a shallow root-system and its large single trunk is not enlarged at the ground. It is killed outright by fire. A. canescens is a rather low whitish shrub with numerous small rigid stems which arise from an enlarged woody base or platform just at or below the surface of the ground. It is highly resistant to fire and crown-sprouts vigorously after a chaparral fire. While it has a very large woody base, the stems which arise from this base are never, so far as observed, over 1 or 2 inches in diameter. Further details of differences between these two species are given in the organized diagnoses below.

Locs.—Iaqua Buttes, *Tracy* 4906; near Castle Peak, ne. Mendocino Co., *Jepson;* Red Mt., n. Mendocino Co., *Eastwood;* Blue Lakes grade to Ukiah, *Jepson;* Cobb Mt., *Jepson;* Mt. St. Helena, *Jepson;* Howell Mt., *Jepson;* w. of St. Helena, Hood's Peak Range, *Jepson;* Mt. Tamalpais, *Jepson* 6803; Loma Prieta (acc. Eastwood); Santa Lucia Peak, *Jepson* 4744, 4745 (glabrate form); Mt. Wilson, *Peirson* 141.

Ref.—Arctostaphylos canescens Eastw. Proc. Cal. Acad. ser. 3, 1:84 (1897), type loc. Mt. Tamalpais, *Eastwood.*

17. A. glandulosa Eastw. is another species which has been reduced to A. tomentosa Dougl. in the latest revision of this genus. (N. Am. Fl. 29: 97—1914). It is a low shrub which crown-sprouts under fire, the root-crown expanding horizontally as a result of repeated fires and forming broad woody platforms from which arise the very rigid erect stems. Its reaction to fire is very remarkable. On a Mt. Tamalpais burn my student, Mr. W. C. Mathews, counted 47 sprouts on a root-crown in one square inch. It forms colonies of a kind entirely different from A. tomentosa and with an entirely different life-history. It also roots freely from decumbent branches.

Locs.—Red Mt., Mendocino Co., acc. *Eastwood;* Ft. Bragg, *W. C. Mathews;* Mendocino Range near Ukiah, *Jepson* 7640; Twin Sisters Peak, Napa Range, *Jepson* 2391; Mt. Tamalpais, *Jepson* 5719, 5720; Berkeley, *Harriet P. Kelley;* Moraga Ridge, *Jepson* 5717; Oakland Hills, *Jepson* 7440 (berries a little glaucous); Las Trampas Ridge, Contra Costa Co., *Jepson;* Sycamore Cañon (head), Santa Inez Mts., *Jepson;* Echo Mt., San Gabriel Mts., *Peirson* 142.

This species is variable and three varieties are here included under it, namely—Var. vestita Jepson n. comb. (A. vestita Eastw.), a shrub of the south coast with leaves densely tomentulose beneath: Ben Lomond, *K. Brandegee;* Monterey, *Jepson* 2991, 4004; San Simeon, *K. Brandegee.* Var. crassifolia Jepson n. var. Leaves elliptic, thick, 8 to 12 lines long.—Del Mar, *Jepson* 1606a (type).

(Cont. p. 88)

Field Trips and Meetings

JANUARY-MAY, 1922

Sunday, Jan. 8. Redwood Peak for study of fungi. Meet at 13th and Broadway, Oakland at 9 a.m. Take Park Boulevard car. Leader, Mr. Harold Parks.

Sunday, Jan. 22. Fort Barry. Take 8:15 Sausalito boat from San Francisco ferry building. Walk from Sausalito. Leader, Miss Amy Rinehart.

Saturday, Jan. 28. Ninth annual dinner of the Society at Y.W.C.A. cottage, Allston Way and Union Streets, Berkeley, at 5:30 p.m. After dinner there will be an entertainment program in the living room of the "Y."

Sunday, Feb. 5. Tennessee Cove, Marin Co. Study of beach and salt marsh flora. Take 8:15 Sausalito boat and train from San Francisco ferry building to Manzanita. Walk to beach. Leader, Mrs. Adeline Frederick.

Sunday, Feb. 19. Lake Lagunitas. Take 8:15 Sausalito boat from San Francisco ferry building to Ross. Leaders, Mr. C. W. Carruth and Mr. W. S. Fields.

Sunday, March 5. Berkeley Hills. Study of native and introduced grasses. Meet at University entrance, Center and Oxford Streets, Berkeley, 9 a.m. Leader, Professor P. B. Kennedy.

Thursday, March 9. Regular meeting in 212 Wheeler Hall, University Campus, Berkeley, at 8 p.m. Lecture on "Utilization of Hybrids in Practical Gardening," by Professor Roy Claussen.

Sunday, March 19. Pilarcitos Lake. Study of trillium and mosses. Take 8:40 electric line from 5th and Market Streets, San Francisco. Ticket to Millbrae and return. Leader, Dr. E. F. Card.

Sunday, April 2. Arequipa Sanatorium and San Anselmo Creek. Objective, study of Aristolochia. Take 8:15 Sausalito boat from San Francisco ferry building to Manor. Leader, Mrs. Y. M. de Reygades.

Thursday, April 13. Annual meeting in 212 Wheeler Hall, University Campus, Berkeley, at 8 p.m. Election of officers. Dr. W. L. Jepson will give a lecture on the subject, "The Giant Redwoods of the North Coast."

Sunday, April 16. Lake Chabot. Meet at triangle, San Leandro, at 9 a.m. Walk up Estudillo Avenue to lake. Leader, Mr. Stephen Wyckoff.

Sunday, April 30. Niles Canyon by auto-bus. Meet at 13th and Broadway, Oakland; start at 8 a.m. Leader, Professor H. E. McMinn. In order to schedule the trip 30 must sign in advance. Remit $1.50 to Mrs. Adeline Frederick, 1636 Woolsey Street, Berkeley.

Sunday, May 14. Major Vanderbilt's gardens for study of intensive and extensive culture of delphinium. Take 8:15 Sausalito boat from San Francisco ferry building to San Rafael. Leaders, Professor Babcock and Mr. J. L. Collins.

May 27 to 30. Annual camping trip. Members desiring to have the special circular send name to Mrs. Adeline Frederick, 1636 Woolsey Street, Berkeley, not later than May 1st.

Verify all train times on latest railway schedules.

Each member should be provided with lunch and cup on all field trips.

Schedule of Field Trips and Meetings

SEPTEMBER, 1922 TO JANUARY, 1923

Sunday, Sept. 17. Ingleside for study of beach flora. Meet at entrance of upper waiting room, San Francisco ferry building, 9:30 a. m. Leader, Miss Edna Finley.

Sunday, Oct. 1. Twin Peaks, San Francisco. Meet at upper waiting room entrance, San Francisco ferry building, 9:30 a. m. Leader, Dr. E. F. Card.

Sunday, Oct. 15. Fort Point. Leave Fort Mason, foot of Van Ness Ave. on U. S. S. Slocum, 9 a. m. From San Francisco ferry take Union St. cars. Leader Miss Amy Rinehart.

Sunday, Oct 29. Bay Farm Island for study of Halophytes. Meet at Lincoln Park station, Alameda, 1:30 p. m. Leader Miss Crocker.

Thursday, Nov. 9. 8 p. m. Regular meeting in 212 Wheeler Hall, University campus. Professor F. T. Bioletti will give a talk on "Botanical Reminiscences."

Sunday, Nov. 12. Hayward Cañon. Meet at 13th and Broadway, Oakland, at 8:30 a. m. Take Hayward car to end of line. Leader, Miss Alsop.

Sunday, Nov. 26. Rockridge, Oakland, for study of fungi. Meet at end of Rockridge car line, 9 a. m. Leader, Mr. Alfred Walker.

Sunday, Dec. 10. Tiburon and Belvedere. Take 1:45 p. m. Tiburon boat from San Francisco ferry. Leader, Dr. Ruth Allen. Those wishing to remain late will provide supper.

Sunday, Jan. 7. Redwood Peak, for study of fungi. Meet at 13th and Broadway, Oakland, 8:30 a. m. Leader, Mr. Harold Parks.

Members are privileged to invite guests to meetings and field trips.

Lunch and cups should be provided on all day trips.

Verify train and boat schedules by latest timetables.

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